HEATING AND VENTILATING

AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION

Effect of Catalytically Cracked Fuels on Oil Burners . . . . . page 61

ffective Exhaust for anks . . page 53

Selection of Medium Size Motors . . . . page 69

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A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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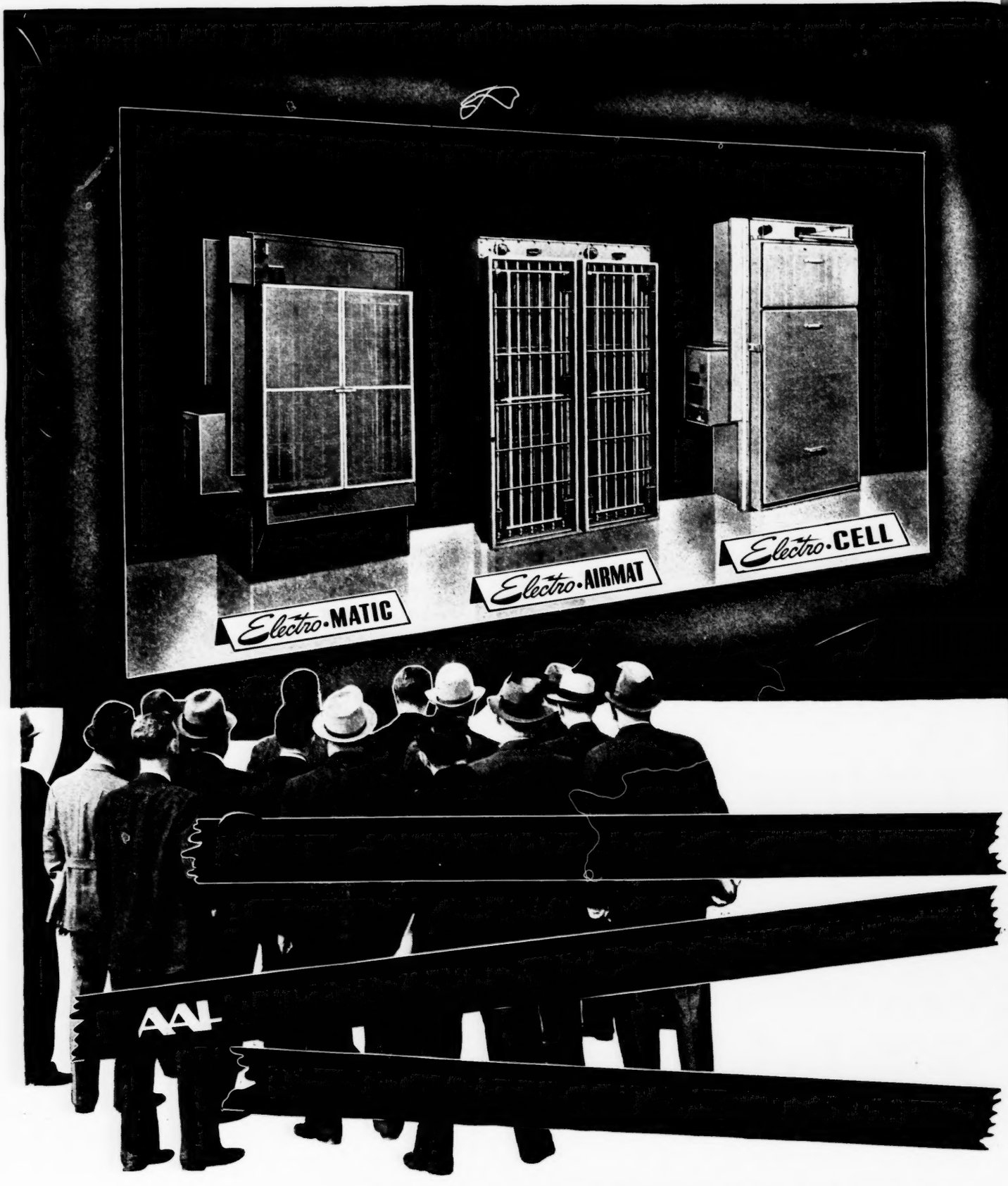
The INDUSTRIAL PRESS

THIS MONTH'S COVER

New fluid catalytic-cracking unit, one of the world's largest, is now in operation at the Philadelphia refinery of Gulf Oil Corp. The effect of this war-developed process on the fuel and burner market is discussed beginning page 61.



● Three types of AAF Electronic Precipitators to meet every air filtration requirement will be on display at Cleveland. Don't miss seeing them!

AAF

Washington News

LORING F. OVERMAN

RETROSPECT – AND PROSPECT

January — traditional look forward-look backward month—suggests a recap of 1946 happenings as a guide to what may be expected in '47. For things are going to be different; possibly not so much as some might wish, but different nevertheless. To trace the pattern,

Let's Look Backward

January of last year brought members of the heating, ventilating and air-conditioning industries new roadblocks not anticipated as post-war dividends. Instead of controls being eased, many were tightened. Priorities Regulation 33, effective January 15, established special priorities for builders giving preference to veterans; set-asides of 10 of the most critical building materials were required; individual home construction was limited to $10,000; and the assigning of priorities to housing placed limits upon commercial, industrial and multi-unit housing. Wilson W. Wyatt took office as Housing Expediter, forecasting that PR 33 would be only the first of a series of drastic housing regulations.

January also witnessed a long and disastrous steel strike requiring a paring down of the entire manufacturing schedule for 1946. The Department of Commerce announced formation of its Construction Division, scheduled to become a clearing house for government-originated data concerning the building industry, with simplification of building codes as a major objective.

February really turned on the heat for the veterans housing program, with Wilson Wyatt succeeding John B. Blandford as National Housing Administrator. Clothed with theoretically unlimited authority to channel materials into his program and to curtail projects interfering, Wyatt announced an ambitious program in which mass-produced housing was scheduled to play an important part. He was active in securing passage of the Lanham Bill, authorizing construction of 100,000 temporary dwellings for veterans and families, at a cost of $250,000,000. Wyatt also recommended, but was unable to secure passage of the Wagner-Ellender-Taft bill, which proposed a permanent housing agency to sponsor slum clearance, research, 32-year amortization, and "planned" local housing activities.

March found Washington and the country embroiled again in a crippling strike, this time in the coal fields. Again estimates of 1946 manufacturing output were scaled downward, but out of it came mutterings that "There ought to be a law" that would make it impossible for a striking few to imperil the best interests of the entire nation. With the mutterings came the realization that there is a law—the Wagner Labor Relations Act—but that this law is apparently needing a bit of revision if labor and management power is to be brought more nearly into balance. April also found OPA weakening in its contention that wages can be raised without increasing prices. In the drafting stage was the first of a series of orders to ease pricing pressure, at first involving only insignificant items.

April brought the growing conflict between private enterprisers and government controllers out into the open. Producers of heavy equipment were particularly vocal in informing Congress that production alone is the answer to current problems, that price control was crippling production, and that until such controls were removed the country's industrial machine would remain at a standstill. Congress consequently passed the word to OPA to start adjusting if it expected an extension of its activites beyond June 30, and it became known that while working under a smoke screen of hold-the-line publicity, OPA was attempting to effect a strategic retreat to a more defensible position.

Also during April, CPA made an effect to temper the construction ban, instructing its 71 field offices to consider the requirements of a sound economy in judging applications for permits for construction in non-housing fields. At the same time, emphasis in the veterans' shelter program shifted from individual homes to rental housing, including apartment. At the same time, although CPA sought to encourage sound-economy building, Priorities Regulation 33 was amended to earmark 50% of all scarce building materials into the Veterans' Housing Program.

May and *June* saw desperation creeping into the Veterans program, with a super-HH rating added in an effort to speed delivery of materials, while pressure on OPA resulted in its death, and subsequent revival a few days later in ghost form. It was becoming apparent that the nation had lost its taste for government controls, and that it would be only a matter of time before a change would be demanded.

July found completed houses for veterans still a long way off; the possibility of increased lumber production was rumored, and, strangely enough, steel production took another dip—this time as a result of lack of scrap. Reasons for some of the delays began to show up in

August awoke to a shortage of freight cars. It seems that in earmarking steel for veterans' housing, it had been denied to manufacturers of cars. Thus, six months later, a shortage of cars imperiled delivery of materials needed for the housing program itself. Again the fallacy of planned tinkering with laws of supply and demand was highlighted, and government control stock took another skid. Some encouragement in the construction field was given by the fact that actual production of building materials continued to rise, both lumber and brick showing marked gain. Wyatt's path began to grow thorny, however, with the Veterans of Foreign Wars demanding a Congressional investigation. Bucking the trend away from government controls, Wyatt said, "It's time to get tough," and began writing new orders to implement his viewpoint.

September proved that Wyatt wasn't fooling. Out came an order requiring drastic set-asides of physical

"Thine alabaster cities gleam"

In *all* the world, *only* in America can be found so great and shining cities.

They are, in one, both the symbol and the accomplishment of our aspirations. They are, ir a way, America. Ask a couple of million returned GIs!

If beyond our alabaster cities we sense the roar of mighty machinery, the belching stacks of industry, the skill and sweat of human beings . . . they obscure not at all the handiwork. For in America we know that not alone with ideals, but with the "sterner stuff" of toil and resources shall a nation be moulded at last.

So, some practical dreamer it was, who watched the first *steel pipe* clank from the grimy benches about sixty years ago. Who, in shaping the hot metal, gave form and substance to fair cities yet to arise . . . cities that became realities because these *arteries* of steel could convey water, oil and other essential fluids, gas, steam and even some forms of solids, over long distances and to great heights.

Actually, the achievement of the modern city directly parallels the development and plentiful production of reliable, economically adaptable *steel pipe.* Yes, *steel pipe makes it possible!*

The interesting story of "Pipe in American Life" will be sent upon request.

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inventories of building materials for indefinite periods —not merely for 30-days. Wyatt contended that many builders, after holding materials for 30 days, let them get away at just the time they were needed by veterans —if they were ever held at all. Set-aside figures were 80% for lumber; 100% for residential hardwood flooring; 85% for millwork; 75% of all plywood, and 75% for 59 other building materials, including many heating and ventilating units. During the same months, OPA indicated it was merely giving lipservice to the idea of decontrol, and up to September 20, not a single industry advisory committee had even attempted to buck the red tape set up by OPA for those seeking decontrol. Similarly, it was not even considering industry wide application for price adjustments. Another September happening—the Government's surrender to striking seamen—set the stage for another round of strikes seeking was increases.

October sounded the real knell of price controls—decontrol of meat prices. OPA bowed to the conclusion that the public had lost faith in such controls, controls came off and OPA began winding up its affairs, promising to really do some decontrolling before Congress convenes in January. Again Wyatt took the bit in his teeth, reducing to $1,000 the amount of factory construction or repair work permitted without prior approval. Rumors of Wyatt's early resignation became current as representatives of 100 trade associations in the construction field met to draft recommendations for new methods of handling the construction problem.

November saw public resentment against Washington controls reach their peak with a switch to a Republican majority in Congress. During the same month, John L. Lewis decided to become the nation's best salesman for fuels other than coal. The number of conversions to oil and gas caused by his untimely coal strike must still be tabulated, as must the public's resentment against legislation that will permit such one-man assaults upon the nation's economy. Wilson Wyatt was seeking a showdown with President Truman late in November over his housing program, but a decision was postponed because of the coal crisis. In the meantime residential construction began dropping, production of building materials was climbing, and inventories were piling up at distributing points because of Wyatt's set-aside orders. Veterans weren't taking the supplies; yet non-housing construction was barred from getting them.

December brought three cheers for President Truman's program of letting John L. Lewis fight it through the courts. As for the President's acceptance of Wyatt's resignation and the subsequent tempering of the veterans housing program, there is much difference of opinion. There were few mourners when the Office of Price Administration and the Civilian Production Administration folded during December, their remaining functions being taken over by a new Office of Temporary Controls.

A Look Forward

What 1947 holds for this country is somewhat foreshadowed by the foregoing recapitulation of its efforts to shake off the shackles of Washington planning. The new Republican-Dominated Congress will take over with considerable assurance that the country wants, or thinks it wants, somewhat less paternalism. Just how far the new Congress can go, or will dare go when it views current problems in the light of political realism, is indeed a question.

One thing would appear certain: that the public is fed up with extreme legislation that favors either labor or management, and that it will demand and support a labor program that is designed to prevent nation-crippling strikes in major industries. On the other hand, the public is equally weary of hurried or loosely worded legislation that permits either side to be legally right although morally wrong, or which may precipitate a rash of such unreasonable demands as those current suits for untold millions of dollars for portal-to-portal pay. Thus, although a revamping of the labor laws will occupy the No. 1 spot on the Congressional calendar, there is much doubt in Washington that satisfactory legislation can be completed speedily.

Believing that an end to portal-to-portal suits is even more important than clarifying the entire labor picture, there is a movement on foot to secure fast action on the Gwynne "hidden bankruptcy" bill. Although passage of this bill would affect only the portal-to-portal phase of the labor problem, legislative strategists hope it may be possible to rush it through before Senators and Congressmen become embroiled in highly controversial phases of the broader subject of labor as a whole.

The Gwynne bill is designed merely to put a one-year statute of limitations on private suits growing out of federal laws. Passage failed narrowly at the last session of Congress, but the present flood of portal-to-portal suits—with countless more certain to come as rapidly as unions and individuals realize the significant of recent Supreme Court rulings—is crystalizing sentiment as to the vital need for such a limitation.

The problem of portal-to-portal pay suits as well as numerous suits under the Wage-Hour law, grew out of the Supreme Court Decision, last June, to the effect that employees are on the job when they enter the plant's gates, despite all historic evidence to the contrary. Coverage of the Wage-Hour Act has broadened immensely by court decisions and administrative interpretations until it has gained such wide scope that even window washers of a service company who work on a building used for production for interstate commerce are affected. This has resulted in thousands of small firms, including retailers, becoming liable for overtime and other payments which they never knew they would be called upon to pay. And, in many states, the suits can ask pay extending back to the enactment of the Wage-Hour Law in 1938. What this could mean is indicated by suits filed in a Pittsburgh Federal court, in which employers were sued for sums ranging from $400 to as much as $5,000 for each of hundreds of employees.

It is pointed out that even when employees admit the unfairness of such suits, either union pressure or the insistence of other less fairminded workers forces the filing. The public, management, and thinking employees appear to have reached a point where they want equitable laws, justly administered.

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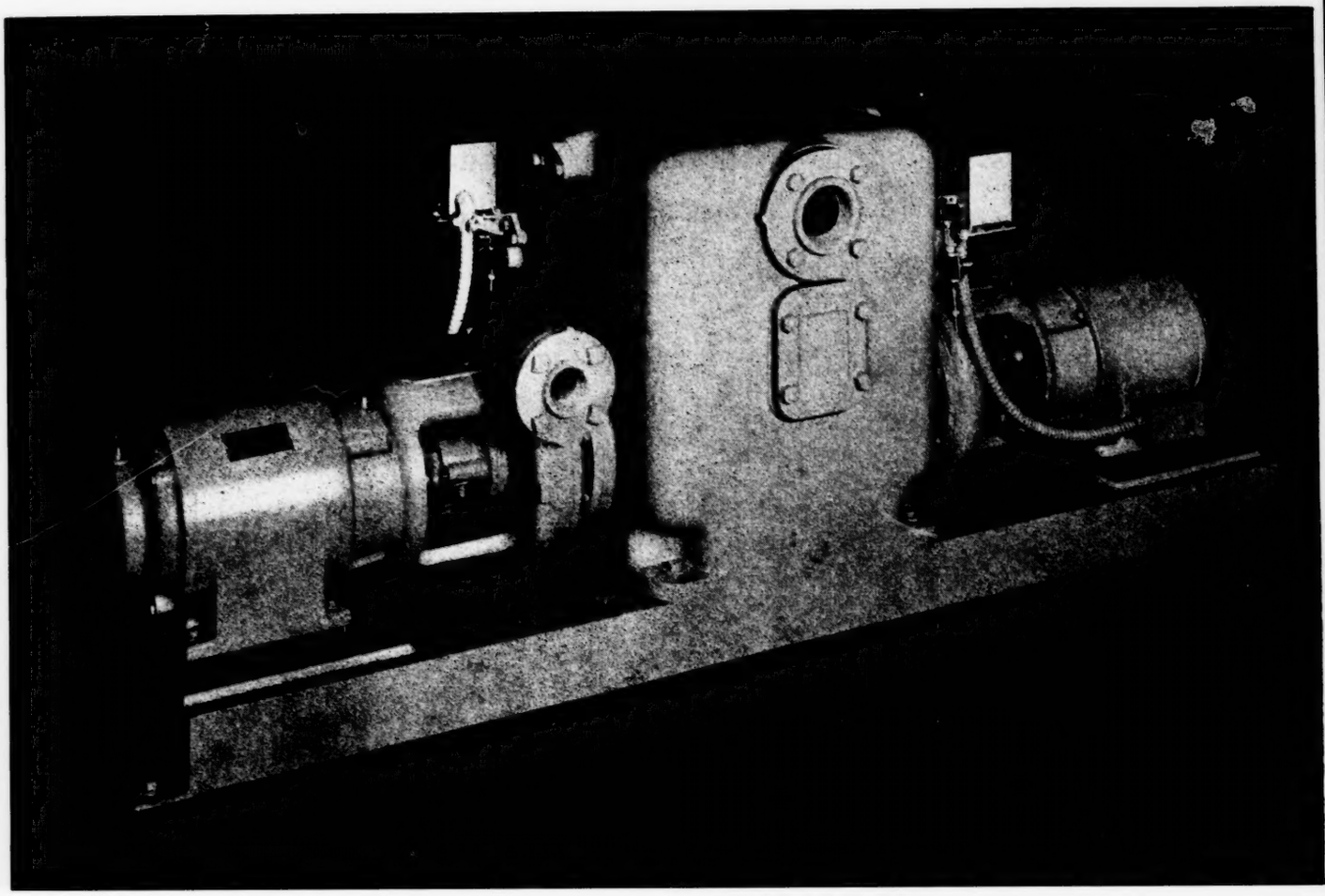

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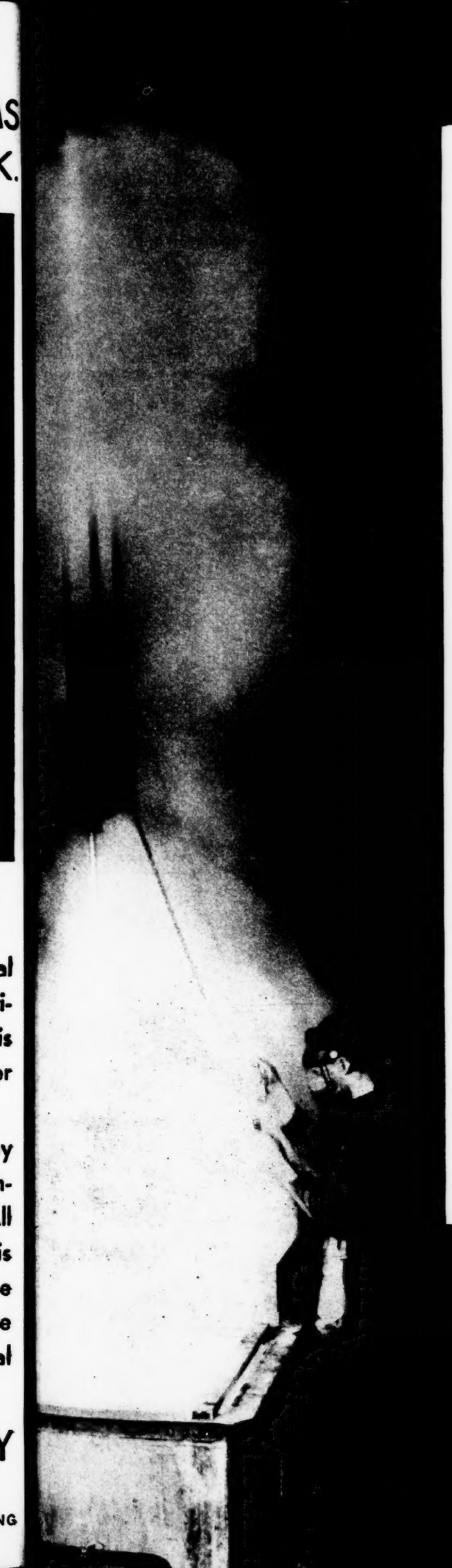


VENTILATING

Effective Exhaust for Tanks

B. F. POSTMAN

Industrial Hygiene Engineer,* Employers Mutual Liability Insurance Co., and

WILLIAM F. BATTISTA†

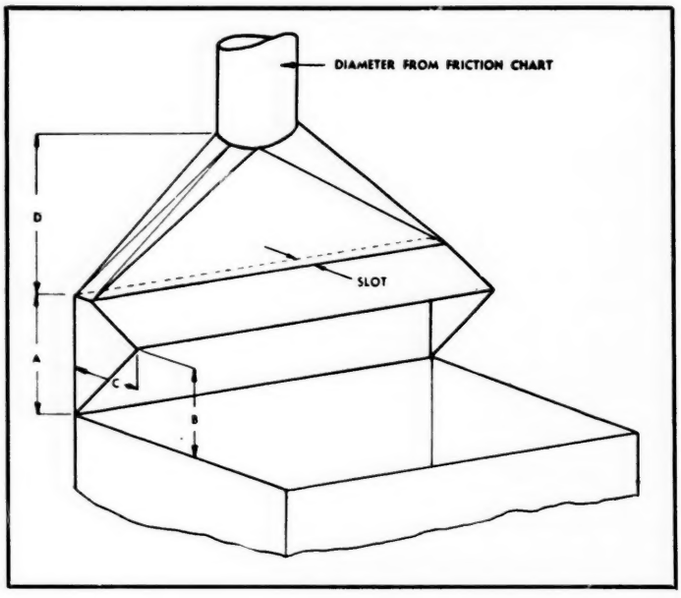
This is the first of a two-part article in which the authors describe a new type hood for exhaust from cleaning, plating and other tanks which has proved its worth in a number of actual installations.

THERE is definite need for effective control of air contaminants or nuisance materials dispersed to the working environment from metal cleaning, plating and other open tank operations, including those in which anti-corrosion or rust-proofing preparations are used.

It is customary to control dispersion from tanks by exhaust through relatively narrow slots forming a part of manifolds installed on one or more sides of a tank. However, the limitations involved in the installation of ductwork and exhaust manifolds to provide adequate control may result in a system design of high initial or maintenance cost. Moreover, the rate of dispersion, particularly in the case of steam, is frequently too high to result in satisfactory removal within reasonable rates of air flow. This consideration assumes added significance since hot water rinse, and hot alkali or stripping tanks, usually basic components of the average plating room, are commonly sources of undesirable humidity as well as possible air contaminants.

Streamlining of modern tank operations, entailing mechanization or tank units and the use of overhead conveyor and monorail systems either manually or automatically

*Formerly Captain, Sanitary Corps, Army Industrial Hygiene Laboratory.
†Formerly 1st Lieutenant, Sanitary Corps, Army Industrial Hygiene Laboratory.



HOOD DIMENSIONS, INCHES

TANK WIDTH	A	B	C	D
24	12	8	9	19
30	16	12	9	19
36	20	12	9	19

Fig. 1. Typical rear-type exhaust hood.

operated, normally precludes the use of so-called overhead, or canopy type hoods. However, this type of hood is not used extensively as a part of modern industrial exhaust systems. Installation of an overhead hood usually locates the breathing zone of the operator between the source of dispersion and the hood —a condition which is not conducive to good engineering control. In many instances, it may be possible to locate the exhaust hood at the rear edge or side of the tank and cover a part of the rear surface of the tank area without interfering with the usual tank operations.

Fig. 1 illustrates a highly effective hood design* utilizing lateral exhaust which has been used successfully for many years by the author. Advantages of this design over the conventional slot located just above the level of the tank edge, includes simpler design, lower entrance loss, possible decreased initial and maintenance costs and improved uniformity of air flow over the entire area of the tank.

The hood is actually made of two sections, the first, or entering section, containing the inclined open face, and the second, or transformation section. The dimensions indicated have proven effective in actual practice but may be varied to suit structural or operational interferences.

The loss through this type of hood, measured in terms of velocity pressure based on the slot velocity used, will probably be closer to 1 vp than to ½ vp. Structural interferences may seriously reduce the height of the transformation section *D* of Fig. 1, or incline this section forward to the front of, or backward to the rear of the tank, so that the center line of the branch connection will not be located in the same plane as the center line of the slot as illustrated in Fig. 2. It is therefore suggested that 1 vp be used for the loss through the hood in calculating the total system loss.

*Basic hood design originally developed by Robert A. Briggs, Jr., Vice-President, Colonial Blower Company, Hartford, Conn.

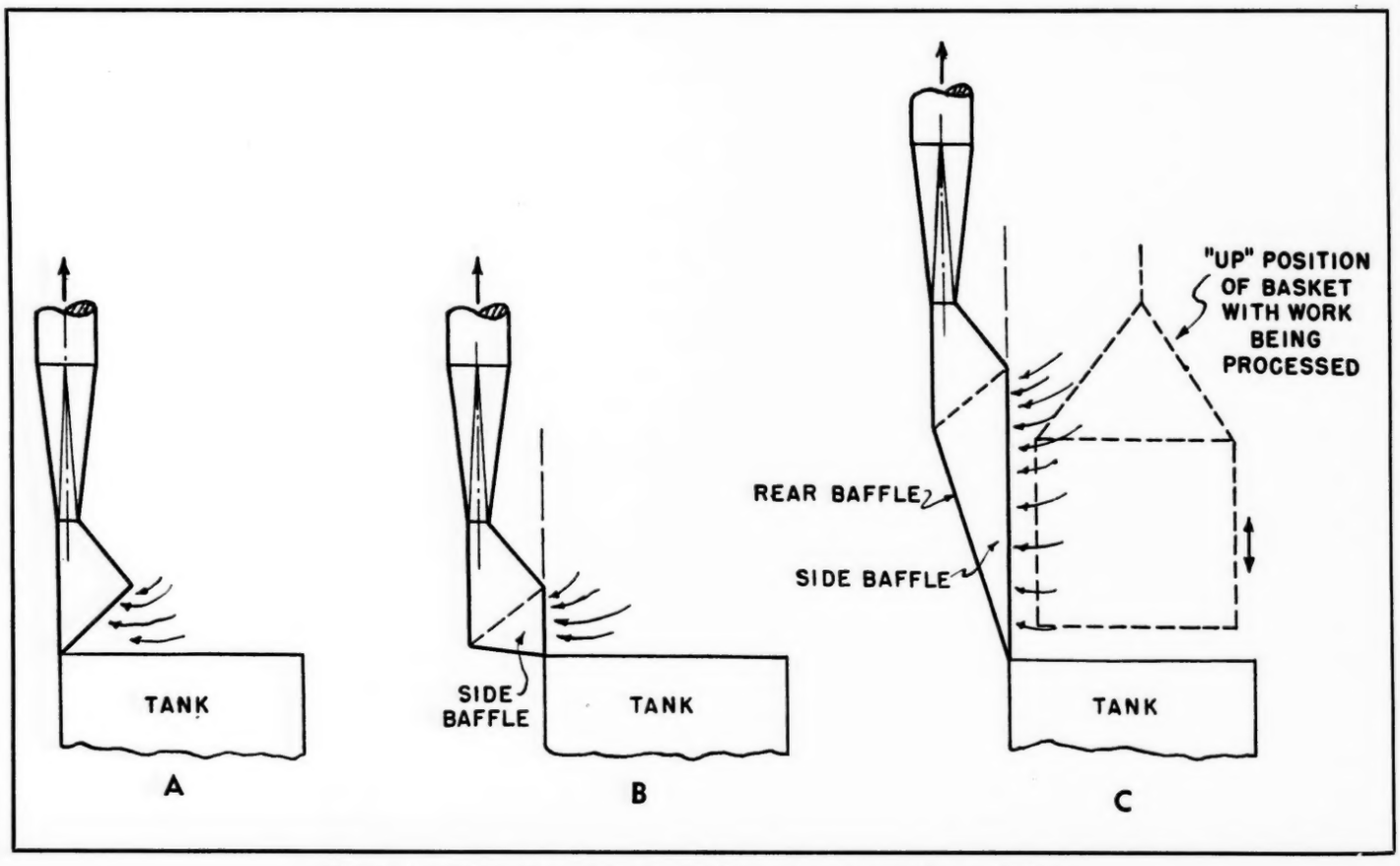


Fig. 2. Location of rear-type hood for various operating conditions.

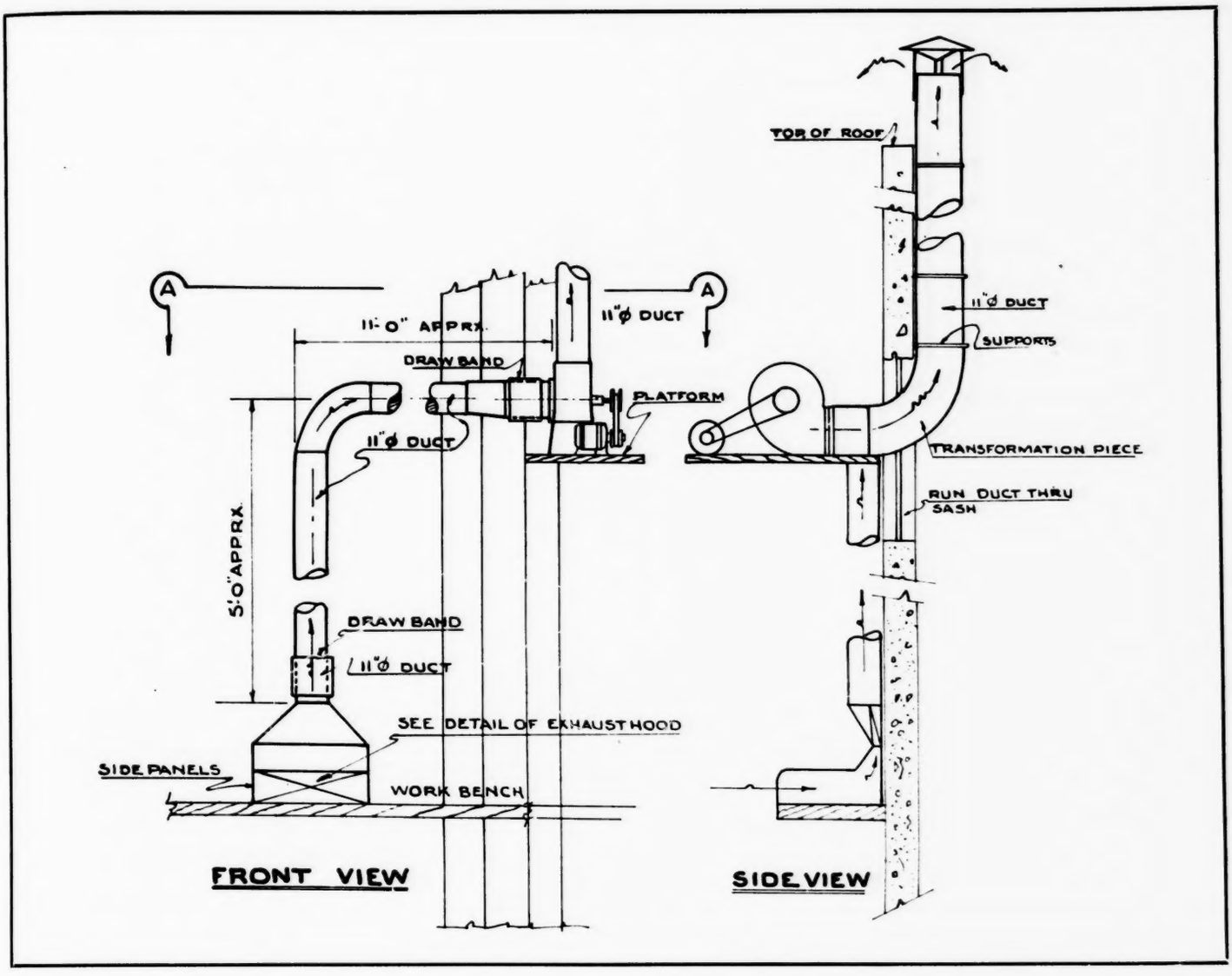


Fig. 3. General arrangement of typical system for control of solvent vapors. Details appear in Fig. 3a. General notes: All dimensions given are approximate and to be checked in the field before starting work. Provide a piece at fan outlet to transform rectangular outlet to 11 in. diameter stack and weather cap. Provide draw bend between hood and piping system. Provide draw band at fan inlet. All piping to be No. 21 ga. G.I. riveted and soldered.

Fan data: 1700 cfm, 1 in. S.P., 1280 rpm, 0.41 bhp. Provide ½ hp 1750 rpm motor. Provide either a non-ferrous wheel or anti-sparking strips on wheel or inside of fan housing to prevent the possibility of sparking irrespective of type of solvent vapors being exhausted. All equipment to be thoroughly grounded. O.D. fan inlet, 15-7/16 in.; O.D. fan outlet, 1-7/8 in. x 16-1/4 in. Fan counter clockwise, bottom horizontal discharge.

A primary feature of this hood is its inclined open face, over which moderately high air velocities are maintained. The controlling factor is the slot, located high inside the hood, through which the air flow is maintained at a selected velocity ranging from 2000 to 3000 fpm. This slot serves to distribute the air flow over the entire slot length, thereby producing a uniform air flow into the open front of the inclined face of the hood.

Fig. 1 shows the hood with a single exhaust connection. The hood length for a single connection should preferably not exceed 4 ft. Long tanks, tables, or benches may therefore be provided with a number of such connections based on multiples of this recommended length. A hood 5 ft long may have one connection but should be provided with a center splitter or baffle plate as an aid in distributing the air flow evenly over the inclined face of the hood. A hood 6 ft long should be provided with two short transformations each 3 ft long.

The three possible locations for this type of hood are illustrated in Fig. 2. At *a*, the most desirable location, the front lip of the hood overhangs the rear edge of the tank by the distance *c* (see Fig. 1). Operating conditions, however, may prevent any hood overhang and require that the hood be moved backward to the position shown at *b* or *c* (Fig. 2). However, hoods installed in these positions are less effective than when in the normally desired position shown at *a*.

This type of hood may be used for controlling steam dispersion from tanks utilized for cleaning, stripping and rinsing operations and for nitric acid bright dip tanks or crocks. It may also be used for bench or table operations where solvent vapors are dispersed of normal evaporation from the surfaces of objects which have been cleaned, or the excessive dispersion

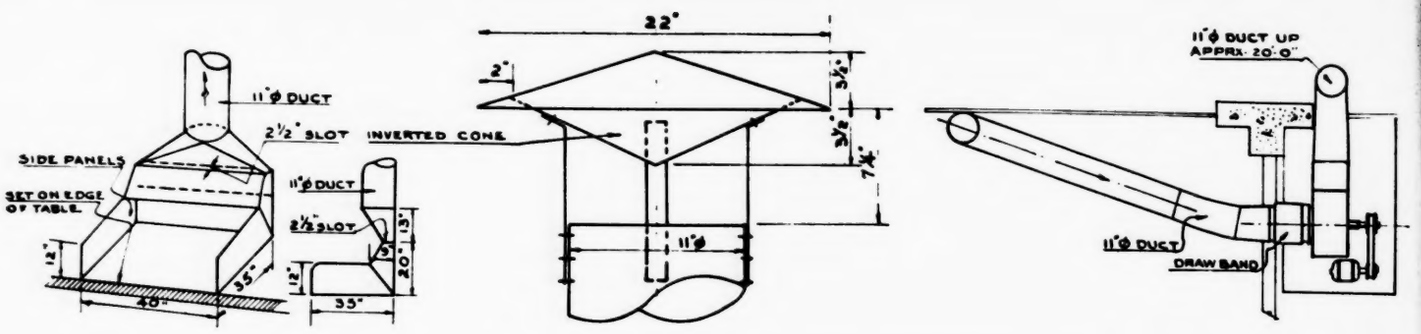


Fig. 3a. Details for system in Fig. 3. Left, detail of exhaust hood; center, detail of weather cap; right, section at A-A.

resulting from the use of a compressed air jet, to facilitate the removal of solvent from recesses within parts being cleaned or processed.

Cleaning of all types of electrical equipment previous to being repaired is best accomplished by use of carbon tetrachloride. Repair men claim that experience has proven this to be so, as other solvents are flammable and seem to leave a deposit on the parts cleaned. This may be a controversial statement as other solvents may possibly do as good a cleaning job, but perhaps do not evaporate as quickly as carbon tetrachloride. Experience has demonstrated, however, *that the more suitable a solvent is for a particular industrial operation, the less suitable or desirable it is for the health of the operator.*

An example of what can be developed in the way of a design for the control of solvent vapors resulting from operations performed at a bench or table is illustrated in Fig. 3 and 3a. The usual procedure is to place the parts to be cleaned in a pan of the solvent; use a stiff brush to remove all adhering grease and accumulations; raise the part from the pan and then apply a jet of compressed air to remove the excess solvent. It is at this point that the operator is severely exposed to the toxic vapors which must be prevented from dispersing to his breathing zone. By providing the control indicated, the operator can apply the jet of compressed air to the part in such a manner that the air stream would be directed towards the hood opening.

The fan capacity indicated, 1700 cfm, is somewhat greater than would be exhausted from a tank of the solvent if the operations were only dipping, rinsing or air drying.

To improve the practicability of the hood arrangement shown, the side panels may be pin-hinged to the side of the hood or be provided with plugs at their lower edge so that the plugs may be inserted in holes in the top of the table or bench. In this manner the side panels may be removed when cleaning is not being performed, thus providing free and unobstructed use of the table top or bench. Once an operator realizes the type of control which is available for his protection, he will use it to the fullest extent.

When large or unwieldy parts cannot be cleaned on a bench or table, they may be cleaned on the floor or on carriages or frames, provided with casters or wheels to improve their mobility. Where solvent cleaning operations are performed in a booth, mechanical exhaust ventilation should be provided, such that a minimum velocity of 150 fpm will be maintained over the entire frontal opening of the booth. If the operation is performed on the floor and compressed air is used to aid in the final removal of excess solvent, downdraft ventilation should be provided through a grille in the floor to maintain a minimum velocity of 250 fpm over the gross area of the floor grille. This air quantity may seem excessive. However, experience demonstrates that unless a downdraft floor grille exhaust is surrounded by four walls, all air movement will *not* be downwards past the breathing zone of the operator but much of the air will be drawn in along the floor adjacent to the grille. The operator may be on his knees or in a crouching position during a portion of the cleaning operation. Then when everything is apparently set, open doors or windows, overhead cranes or unit heaters may tend to disturb what should be a turbulent-free atmosphere, a condition which is rarely present in any industrial plant. All of these compensating negative influences must be considered or else the results of the installed design will be disastrous.

Notable success has been achieved with this type of hood when used to control dispersion from nitric acid bright dip operations. When brass parts are dipped into a crock or tank of nitric acid, though there is a considerable evolution of oxides of nitrogen and other gases from the acid and the parts themselves, this evolution is tremendously increased when the parts are quickly immersed in an adjacent water rinse tank. The standard slot type of exhaust provided along the upper edge of one or more of the longitudinal sides of the tank will not provide adequate control for this type of operation. Once the contaminant is beyond the zone of influence of the suction of the slot, it is almost impossible to adequately control the dispersion. As a result of the combination of the chemical action of the acid on the brass and the upward movement of the parts as they are withdrawn from the bright dip tank or crock, practically all of the contaminants are given an upward movement. It is at this point that the type of hood being discussed, demonstrates its effectiveness. Depending on the tank width, the forward lip of the hood is located from 8 to 16 in. above the surface of the tank. This provides considerable area *in the zone of contaminant dispersion* for the air, which is being drawn into the front of the hood, to envelop practically all of the contaminants before they have an opportunity to disperse to the breathing zone or working area.

Next month the authors will present a series of examples showing applications of tank exhaust.

Preview of Events at Cleveland

January 27-30, 1947

7th International Heating and Ventilating Exposition

53rd Annual Meeting, American Society of Heating and Ventilating Engineers

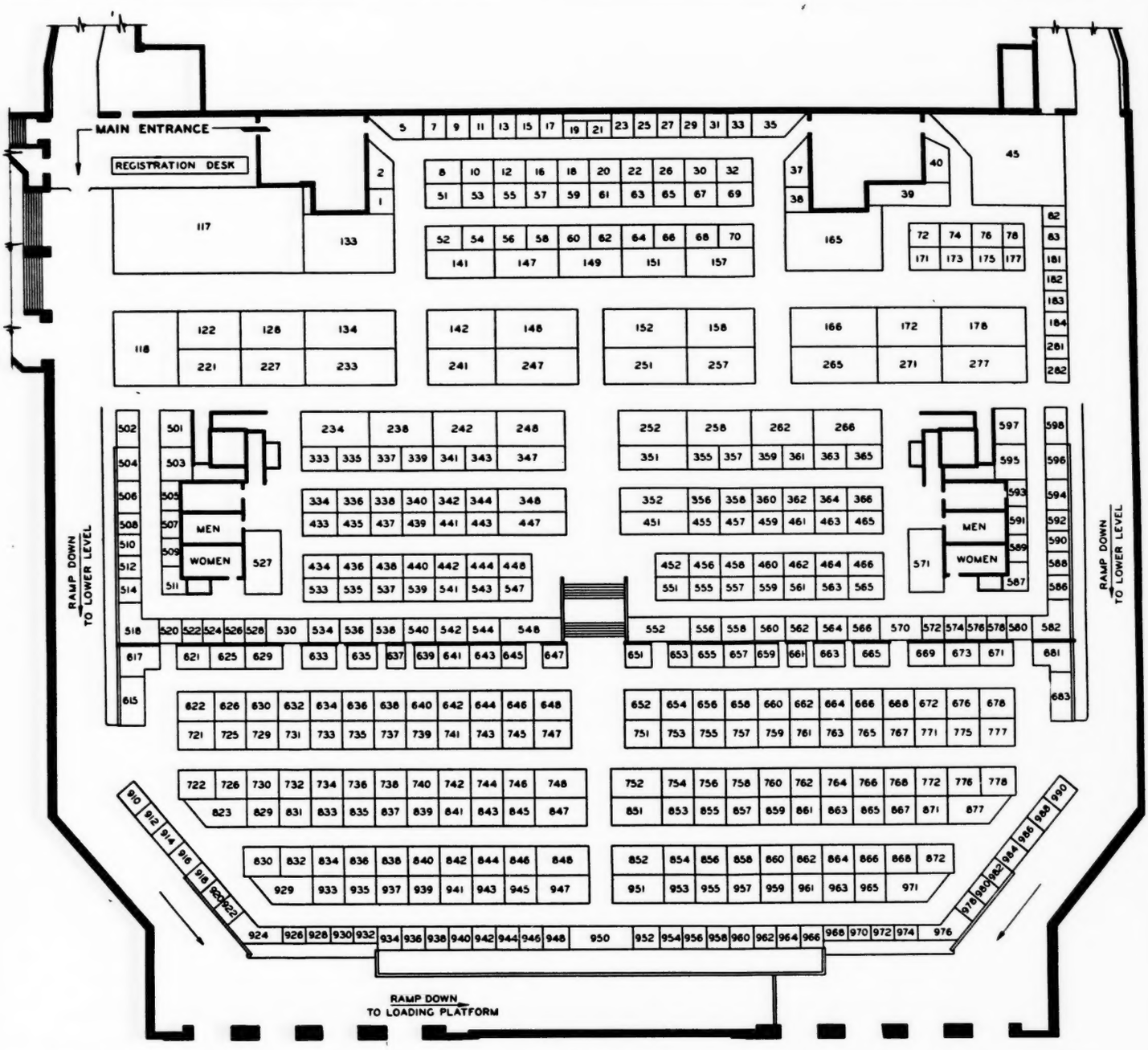
33rd Annual Convention, National Warm Air Heating and Air Conditioning Association

Cleveland will be the center of attraction for those in the heating, ventilating, and air conditioning field when the 7th International Heating and Ventilating Exposition at Lakeside Hall will serve as the rallying point for two association conventions. The 53rd Annual Meeting of the American Society of Heating and Ventilating Engineers will open Monday, January 27, at the Hotel Statler while the 33rd Annual Convention of the National Warm Air Heating and Air Conditioning Association will open on Thursday, January 29, at the Hotel Cleveland. Programs of both societies and the list of exposition exhibitors are presented on these pages.

Exhibitors at the Exposition

(Floor plan on next page)

Space No.	Exhibitor
22	Ace Engineering Co.
663	Acme Industries, Inc.
843	Adams Mfg. Co.
271	Aerofin Corp.
508	Air Conditioning Association of Cuyahoga County
644-642-741-743	Air Conditioning & Refrigeration Div., Worthington Pump & Machinery Corp.
547	Air Conditioning & Oil Heat Magazine
976	Air Conditioning & Refrigeration News
262	Air Controls, Inc.
1 & 2	Air Control Products, Inc.
5-7	Air Devices, Inc.
67-69	Air-Maze Corp.
72-74-76-78	Airtemp Div.-Chrysler Corp.
635	Airtherm Mfg. Co.
12 & 16	Aldrich Co.
722-726	Allis-Chalmers Mfg. Co
929-933-935	American Air Filter Co., Inc.
522	American Artisan
837-839	American Flange & Mfg. Co., Inc.
45-555-557 559-561	American Gas Assoc., Inc.
117	American Radiator & Standard Sanitary Corp.
986	American Ship Building Co., Delta Ship Building Div.
100	American Society of Heating & Ventilating Engrs.
572-574	American Society of Refrigerating Engrs., The
234	American Stove Company-Lorain Div.
177	Anderson Co., The V. D.
165	Anemostat Corp. of Amer.
645	April Showers Company
11	Armstrong Machine Works
11	Armstrong Steam Trap Co.
647	Auer Register Co.
980	Au-Temp-Co Corp.
30-32	Automatic Firing Corp.
625	Automatic Devices Co., Weather Controls Div.
343	Automatic Humidifier Co.
540-542	Automatic Products Co.
640	Avery Engrg. Co., The
948	B.G.B. Mfg. Co.
184	Bacharach Industrial Instrument Co.
982	Badger Corp.
171-173 681	Barber-Colman Co. Bard Mfg. Co., The
362	Barnes & Jones, Inc.
861	Bear Mfg. Co.
852	Barton Company, The
341	Beaton & Cadwell Mfg. Co., The
221	Bell & Gossett Co.
742-744-746	Bendix Aviation Corp., Friez Instrument Div.
760	Bishop & Babcock Mfg. Co., The
655-657	Black & Decker Mfg. Co., The
636-638	Borg-Warner Corp., Ingersoll Steel Div.
848	Borg-Warner Corp., Norge-Heat Div.
928-930	Boston Machine Works Co.
466	Breuer Electric Mfg. Co.
966	Brown Electric Co.
248 & 347	Brown Instrument Co.
510	Brundage Co., The
158	Buffalo Forge Co.
122	Burnham Boiler Corp.
507	Calumet & Hecla Consolidated Copper Co., Wolverine Tube Div.
594	Cargocaire Engrg. Corp.
233	Carrier Corp.
842	Carter Coal Co.
637	Central Die Casting & Mfg. Co.
845-847	Century Engrg. Corp.
439	Chace Co., W. M.
659	Char-Gale Mfg. Co.
266	Chicago Pump Co.
72-74-76-78	Chrysler Corp. — Airtemp Div.
729-731	Clarage Fan Co.
459-461	Clayton & Lambert Mfg. Co., Middletown Div.
846	Cleaver Brooks Co.
178-277-598	Cleveland Steel Products Corp.
58-60-62	Coleman Co., Inc., The
339	Cole Sewell Engrg. Co.



Floor plan of exhibition hall with space numbers shown. Exposition open from 12:00 noon to 10:30 p. m. daily.

Space No.	Exhibitor
639	Combustion Control Corp.
651	Commercial Filters Corp.
656-658	Conco Engrg. Works, Div. of H. D. Conkey & Co.
571	Connor Engrg. Corp., W. B., Dorex Div.
854	Consolidated Industries, Inc.
775-777	Consolidation Coal Co.
841	Continental Instrument Co.
763-765-767-771	Coroaire Heater Corp.
955-957-959	Crane Co.
8	Crotty Mfg. Corp.
541-543	Curtis Refrigerating Mch. Div., Curtis Mfg. Co.
863-865	Cyclotherm Corporation
460-462	Dayton Rubber Mfg. Co., The
934-936	Delavan Engrg. Co.
730-732-829-831	Delco Appliance Div., General Motors Corp.
942-944	Detroit Gas Regulator Co.
834-836-838	Detroit Lubricator Co.
21	Dielectric Prods. Co., Inc.
39-40	Dodge Corp., F. W.
621	Dole Valve Co., The
357	Domestic Engrg.
357	Domestic Engrg. Catalog Directory
745	Domestic Engine & Pump Co.
357	Domestic Engrg. Co.
661	Dongan Electric Mfg. Co.
456-458	Dowagiac Steel Furnace Co.
19	Doyle Vacuum Cleaner Co.
947	Dravo Corp.
333-335	Drayer-Hanson, Inc.
148	Dunham Co., C. A.
265	Duo-Therm Div. Motor Wheel Corp.
937	Dwyer Mfg. Co., F. W.
972-974	Effecto Grille Corporation
736-738-740	El Van Ayre Corp.
534	Emerson Elec. Mfg. Co., The
520	Enterprise Eng. & Fdry. Co.
733-735-737-739	Fairbanks-Morse & Co.
576	Farr Co.
281-282	Fedders-Quigan Corp.
25	Field Control Div.—H. D. Conkey & Co.
26	Fireline Stove & Furnace Lining Co.
258	Fitzgibbons Boiler Co., Inc.
536-538	Forest City Fdrys. Co.
544	Freeman Stoker Div. — Illinois Iron & Bolt Co.
751	Frick Co.
742-744-746	Friez Instrument Div. — Bendix Aviation Corp.
547	Fueloil & Oil Heat Magazine
434-436	Fulton Sylphon Co., The
142-241	Gar Wood Industries, Inc.
924-926	General Bronze Corp.
157	General Controls Co.
752	General Electric Co.
916	General Filters, Inc.

Space No.	Exhibitor
730-732-829-831	General Motors Corp., Delco Appliance Div.
646-648	General Plate Div., Metals and Controls Corp.
562	Goodyear Tire & Rubber Co.
961	Greenlee Tool Co.
338-340	Grinnell Co., Inc.
509	Guardian Prods. Corp.
355	Harris & Co., Arthur
530	Hart & Cooley Mfg. Co.
503	Harvey Whipple, Inc.
552	Heating, Piping and Air Conditioning
547	Heating Publishers, Inc.
342-344	HEATING AND VENTILATING
669-673	Heating Research Corp.
242	Heil Co., The
247	Henry Furnace Co., The
334-336	Henry Valve Co.
18	Herco Oil Burner Corp.
134	Hoffman Specialty Co.
82-83	Holcomb & Hoke Mfg. Co., Ventilating Div.
823	Home Ease Prods. Div., Inc., Bogue Elec. Co.
437	Hopwood & Assoc., Inc., J. W.
938	Holleran Metal Prods,, Div. of O'Halloran Ind.
590-592	Ice Air Conditioning Co., Inc.
64	Illinois Engrg. Co.
544	Illinois Iron & Bolt Co.
10	Illinois Testing Laboratories, Inc.
63	Imperial Brass Mfg. Co.
448	Independent Register Co.,
342-344	Industrial Press, The
537	Ingersoll-Rand Co.
636-638	Ingersoll Steel Div., Borg-Warner Corp.
677	Insul-Wool Insulation Co.
939-941-943-945	Iron Fireman Mfg. Co.
871-877	Jackson & Church Co.
587	Jackson Gas Burner Co., Inc.
734	Jefferson Electric Co.
455-457	Jenkins Bros.
641-643	Johns-Manville
950	Johnson Co., S. T.
527-528	Johnson Service Co.
833-835	K. & F. Distributing Co.
918	Kauffman Air Conditioning Corp.
452	Kaustine Co., Inc.
552	Keeney Publishing Co.
502	Kehm Corp., The
363	Kent Co., Inc., The
962-964	Kewanee Boiler Corp.
851	Koven & Brother, L. O.
940	Kresno-Stam Mfg. Co.
593	Kreuger Sentry Gauge Co.
442-444	Lau Blower Co., The
438-440	Linde Air Prods. Co., The
844	Link-Belt Co., Stoker Div.
65-952	Liquidepth Indicators, Inc.
867	Lonergan Mfg. Co.
745	McAlear Mfg. Co.
634	McCord Corp.
141	McDonnell & Miller, Inc.
257	McQuay, Inc.
441	Maid-O'-Mist, Inc.
660	Marsh Corp., Jas. P.
443	Mel Products Co., The
563-565	Mercoid Corp., The
175	Mid-Continent Metal Prods. Co.
910-912-914	Miller Co., The
248-347	Minneapolis - Honeywell Regulator Co.
548	Modine Mfg. Co.
13	Monarch Mfg. Works, Inc.
463	Moore Co., The
748	Morrison Products, Inc.
630	Morse-Smith-Morse, Inc.
265	Motor Wheel Corp., Duo-Therm Div.
518	Mueller Brass Co.
356-358-360	Mueller Furnace Co., L. J.
252-351	Nash Engrg. Co., The
633	National Oil Burner Co.
352	National Radiator Co., The
27	National Thermal Drive Co., Inc.
368	National Warm Air Heating and Air Conditioning Association
118	Niagara Blower Co.
848	Norge-Heat Div., Borg-Warner Corp.
15-17	Norman Products Co.
247	Olsen Mfg. Co., The C. A.
652-654	Owens-Corning Fiberglas Corp.
20	Pacific Mfg. Corp.
840	Paragon Electric Co.
522-524	Patterson-Kelley Co., Inc.
551	Peerless Mfg. Corp.
181-182-183	Penn Electric Switch Co.
133	Perfection Stove Co.
52-54-56	Perfex Corp.
622-626-721-725	Petroleum Heat & Power Co.
65 & 952	Petrometer Corp.
506	Pittsburgh Corning Corp.
26	Pilbrico Jointless Firebrick Co.
365	Plumbing & Heating Journal
954-956-958-960	Pocahontas Fuel Co., Inc. Stoker Div.
745	Power Plant Supply Co.
37-38	Preferred Utilities Mfg. Corp.
588	Premier Burner Co., The
596	Products Research Co.
615	Pyle-National Co., The, Industrial Multi - Vent Div.
51-53	Quaker Mfg. Co.
932	Quist Heet Mfg. Corp.
359-361	Randall Graphite Products Corp.
582	Raytheon Mfg. Co., Industrial Electronics Div.
586	Research Products Corp.
526	Redmond Co., Inc.
505	Reynolds Metals Co.
364-366	Reznor Mfg. Co.
864-866-868-872-963-965-971	Rheem Mfg. Co.
533-535	Rhoads & Sons, J. E.
128	Richmond Radiator Co.
562	Ric-wiL Co., The
951-953	Ridge Tool Co., The
759-761	Roberts-Gordon Appliance Corp.
465	Rome-Turney Radiator Co.
772-776-778	Russell Co., The F. C.
514	Rutledge Boiler Co.
653	Sampsel Time Control, Inc.
451	Sarco Co., Inc.
970	Schild Mfg. Co.
867	Schwitzer-Cummins Co.
968	Scientiae Corp.
365	Sheet Metal Worker
978	Skuttle Mfg. Co.
922	Smith Corp., A. O.
539	Smith Co., Inc., The H. B.
512	Snips Magazine
988-990	Southwind Div., Stewart Warner Corp.
646-648	Spencer Thermostat Co., Metals & Controls Corp.
30-32	Stok-A-Fire Co., Inc.
518	Streamline Pipe & Fittings Div., Mueller Brass Co.
337	Strong, Carlisle & Hammond Co.
683	Sundstrand Mch. Tool Co.
859	Sun-Fire Stoker Corp.
754-756-758-853-855-857	Surface Combustion Corp.
59-61	Syncromatic Corp.
333-335	Taco Heaters, Inc.
227	Thatcher Furnace Co.
589-591	Temp-Control, Inc.
772-776-778	Thermoseal Div., The F. C. Russell Co.
251	Timken Silent Automatic Div. Timkin-Detroit Axle Co.
560	Tinnerman Products, Inc.
501	Torrington Mfg. Co., The
66-68-70	Trane Co., The
920	Trerice Co., H. O.
564	Triplex Heating Specialty Co., The
972-974	Turnbull Heating Co.
946	Tuthill Pump Co.
464	Tuttle & Bailey, Inc.
665	United States Air Conditioning Corp.
856-858-860	United States Radiator Corp.
556-558	United States Register Co.
9	United States Testing Co.
862	Universal C. I. T Credit Corp.
595-597	Utility Appliance Corp.
433-435	Viking Air Cond. Corp.
166	Viking Mfg. Corp., The
504	Viking Pump Co.
594	Vinco Co., Inc.
566-570	Walton Laboratories, Inc.
851	Waterfilm Boilers, Inc.
348	Waterman-Waterbury Co., The
629	Watts Regulator Co.
830-832	Webster Electric Co.
147-149-151	Webster & Co., Warren
447	Weil-McLain Co.
745	Weinman Pump Co.
762-764-766-768	Westinghouse Electric Corp. Sturtevant Div.
511	Wheeling Furnace Corp.
172	White-Rodgers Elec. Co.
238	Whittington Pump & Engrg. Co.
632	Will-Burt Co., The
753-755-757	Williams Oil-O-Matic Div., Eureka Williams Co. Co.
578-580	Willoughby Machine & Tool Co.
984	Wilson & Co., Inc., Air Filter Div.
747	Wing Mfg. Co., L. J.
507	Wolverine Tube Div.—Calumet & Hecla Consolidated Copper Co.
142-241	Wood Industries, Inc., Gar
642-644-741-743	Worthington Pump & Machinery Corp.
23	"X" Laboratories, Inc.
617	Yarnall-Waring Co.
152	York Corp.
662-664-666-668-672-676-678	York Heat Div., York-Shipley, Inc.
55-57	Young Radiator Co.

PROGRAMS

53rd ANNUAL MEETING
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

January 27–30, 1947 • Hotel Statler, Cleveland, Ohio

Monday – January 27

8:30 a. m. Registration (Hotel Statler)

10:00 a. m. Opening Session (Research Laboratory)
- Dedication of Research Laboratory
- Reports of Officers
- Air Flow into Suction Openings, by A. D. Brandt and R. J. Stoffy
- Reports of Committees
- Report of Tellers of Elucation

12:00 Noon Research Luncheon (Quad Hall Restaurant—7500 Euclid Ave.)

12:45 p. m. Inspection Trips:
- 1:15 p. m. Visit to Nela Park Lighting Institute
- 3:45 p. m. Visit to AGA Laboratory

2:00 p. m. Opening of Exposition (Lakeside Hall)

2:30 p. m. Chapter Delegates Meeting (Research Laboratory)

9:30 p. m. Operation Relaxation (Hotel Statler-Ballroom)
- Informal Musical and Comedy Program with One Act Play by Chagrin Valley Little Theater.

Tuesday – January 28

8:30 a. m. Registration (Hotel Statler)

9:30 a. m. Technical Session (Hotel Statler—Grand Ballroom)
- The Effect of Moisture Content on the Diffusion of Odors in Air, by Richard L. Kuehner
- Dehumidification—Methods and Applications, by John Everetts, Jr.
- Rating Dynamic Dehumidification Equipment, by E. R. Queer and E. R. McLaughlin

12:00 Noon Exposition (Lakeside Hall)

2:00 p. m. Panel and Radiant Heating Forum

5:30 p. m. Social Hour (Hotel Statler—Euclid Room)

6:30 p. m. Past Presidents' Dinner (Hotel Statler—Tavern Room.)

Wednesday – January 29

8:30 a. m. Registration (Hotel Statler)

9:30 a. m. Technical Session (Hotel Statler—Grand Ballroom)
- Practical Considerations in Determining Human Tolerance to Heat, by Willard Machle, M. D.
- Methods Used in Determining Health Hazards Arising from the Inhalation of Various Chemicals, by F. F. Heyroth.
- Minimum Replenishment of Air for Living Spaces Under Conditions of Mechanical Cooling, by W. V. Consolazio

12:00 Noon Exposition (Lakeside Hall)

12:45 p. m. Inspection Trip:
- Visit to Laboratory of National Advisory Committee for Aeronautics.

2:00 p. m. Chapter Delegates Meeting, Hotel Statler—Lattice Room)

7:00 p. m. Annual Banquet (Hotel Statler Ballroom)
- Toastmaster: L. T. Avery
- Presentation of Past President's Emblem

Thursday – January 30

9:30 a. m. Technical Session (Hotel Statler)—Euclid Ballroom)
- Response and Lag in the Control of Panel Heating Systems, by F. W. Hutchinson
- Unfinished Business
- New Business
- Installation of Officers

12:00 Noon Exposition (Lakeside Hall)

2:30 p. m. Joint Session—*National Warm Air Heating and Air Conditioning Association.*
- Proposed Design Procedure for Large, Mechanical Warm Air Heating Systems, by Prof. S. Konzo.
- Bacterial Air Sampling, by Matthew Luckiesh and A. H. Taylor

4:00 p. m. Council Meeting

33rd ANNUAL CONVENTION
NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION

January 29–30, 1947 • Hotel Cleveland, Cleveland, Ohio

Wednesday – January 29

9:00 a. m. Registration

10:00 a. m. Opening Session, Frank E. Mehrings, Presiding
- On The Threshold of Opportunity, by Frank E. Mehrings, President
- Foreman . . . Management, Team Mates or Bargaining Units, by H. J. Post, The National Association of Foreman
- Our New Research Residence, by Frank L. Meyers, Chairman, Research Advisory Committee
- What The Indoor Comfort Program Means To Dealers, by Hugh Thompson, Chairman, Dealers Committee
- What The Association Is Doing For Wholesalers and Distributors, by A. M. Vorys, Chairman, Jobbers Committee
- Election of Officers and Members of the Board of Directors

12:30 p. m. Luncheon Session (Admission by Ticket)
- Guest Speaker, Allen W. Rucker, President, Tool Owners Union

2:15 p. m. Afternoon Session, Atlee Wise, Presiding
- Results of Publicity, Merchandising and Educational Activities, by J. R. Scott, Chairman, Publicity and Merchandising Committee
- Publicity and Promotion, by E. R. Preble, Vice-President, Griswold-Eshleman Co.
- Demonstration of Indoor Comfort Conferences for Dealers, by E. L. Sylvestor, Vice-President, Florez, Inc.
- How To Plan For Indoor Comfort Conferences, by G. A. Voorhees, Application Engineering Director
- Summarization, by F. E. Mehrings, President, and J. R. Scott, Chairman

Thursday – January 30

9:30 a. m. Morning Session, C. S. Franke, Presiding
- New Warm Air Research Residence, by R. W. Roose, Special Research Assistant, University of Illinois
- Furnace Blower Research, A New Investigation, by N. A. Buckley, Special Research Assistant, University of Illinois
- Resistance of Branch Take-Off Fittings in Extended Plenum, by S. Konzo, Special Research Professor, University of Illinois
- Committee Reports:
  - F. L. Meyer, Chairman, Research Advisory Committee
  - W. D. Redrup, Chairman, Installation Codes Committee
  - Professor L. G. Miller, Chairman, Technical Education Committee
  - Guy A. Voorhees, Application Engineering Director

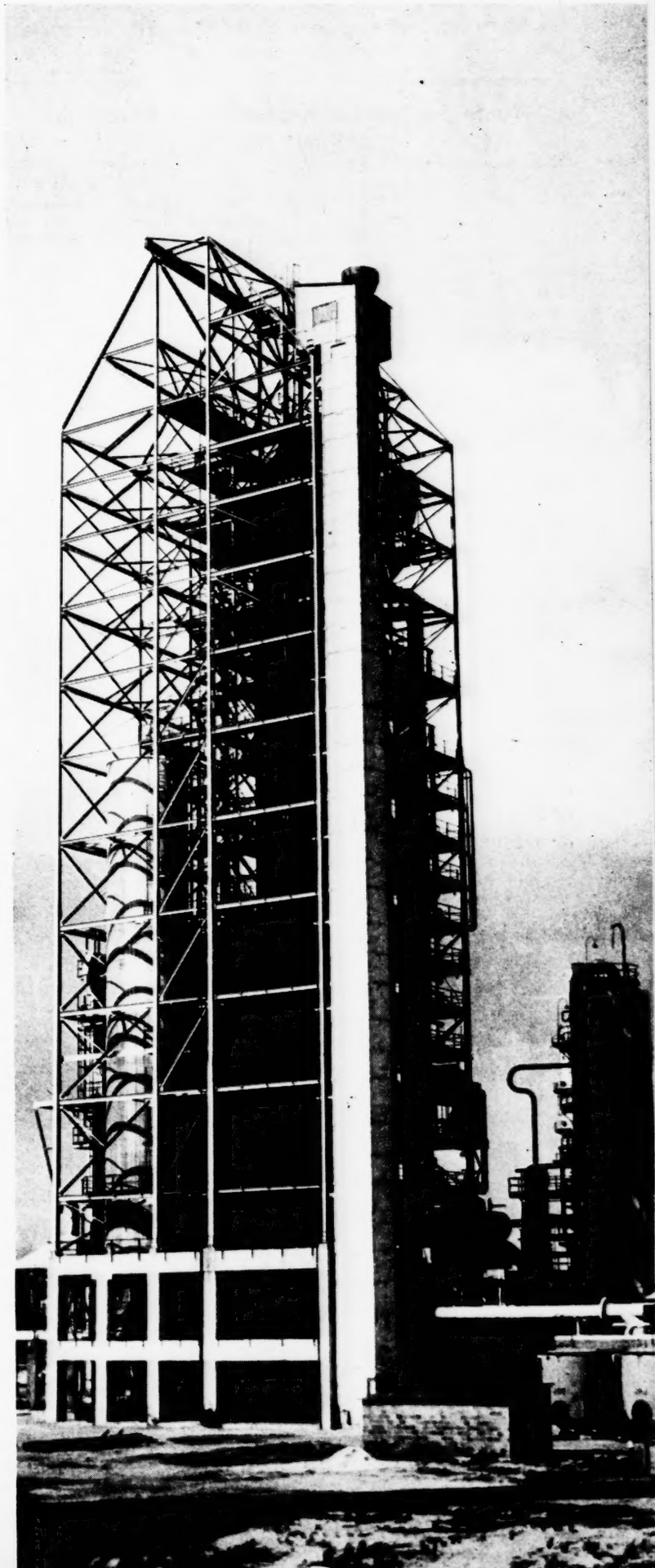
2:30 p. m. Joint Session — *American Society of Heating and Ventilating Engineers*

Effect of Catalytically Cracked Fuels on Heating System Design

E. B. DELGASS
Supervisor, Product Engineering Division,
Technical Service Laboratories, Socony Vacuum Oil Co., Inc.,
and

B. S. GARRETT
Engineer, Product Engineering Division,
Technical Service Laboratories, Socony Vacuum Oil Co., Inc.

Increased production of catalytically cracked fuels has prompted the question of what results can be obtained when this fuel is used with various burners. Findings obtained from a series of experiments using various grades of fuel oils are summarized. Tests show favorable results with vaporizing pot-type burners.



MUCH has been said pro and con regarding catalytically cracked fuel oil, and its effect on fuel oil burner design, the installation of these units, and methods of better utilizing this fuel. However, there is much to be discussed before catalytically cracked fuels are fully understood. The question which arises at this point is why has the oil industry changed from production of straight run to production of catalytically cracked fuels.

Although the catalytic cracking process from which the fuel derives its name is generally considered to be a "war baby," actually, the process was fairly well developed before the war. Unprecedented requirements of the war period for high octane gasolines was a stimulant but not a basic cause.

Development of more and better petroleum products from a barrel of crude oil is a continuing project in the oil industry and the catalytic cracking process is just another step in this direction.

Foreseeing a trend toward increased utilization of catalytically cracked stock in fuel oils, this company conducted a series of tests and experiments to compile data for burner manufacturers and heating engineers. These experiments, conducted at Socony-Vacuum's Technical Service Laboratory in Brooklyn, were carried out with various grades of fuel oils, containing different percentages of catalytically cracked oil. Throughout these experiments it was kept in mind that quite conceivably a 100% catalytically cracked fuel may be marketed within a few years. Findings of these tests are available, free of charge, to burner manufacturers.

This article has been prepared on the basis of results of such experiments and to discuss the effects the advent of catalytically cracked fuel has had and will have for the heating engineer.

For clarification, we have divided the subject into two parts:

(1) Description of the effects of catalytically cracked fuel oil on burner performances, and an outline of the problems which must be solved by cooperation between oil companies and burner manufacturers to insure wider acceptance of oil heating and customer satisfaction, and—

(2) Origin and characteristics of catalytically cracked fuels and how they differ from pre-war fuels.

Table 1 — Typical Inspections of Domestic Fuel Oils

	Kerosene	No. 2 Fuel— Straight Run	No. 2 Fuel— Current Type	No. 2 Fuel— Cat. Cracked
Gravity, Deg. API...	42.5	38.1	32.9	27.2
Color, ASTM.....	Water white	1½	2	2½
Distillation, ASTM				
F for 10%.....	366	402	390	457
F for 50%.....	428	499	497	505
F for 90%.....	494	593	590	597
Carbon residue, 10% bottoms.....	—	0.03	0.05	0.09
Diesel index.....	65	58	42	32
Pour, F.....	—50	0	—10	—15
Sulfur, % weight...	0.05	0.12	0.15	0.16
Corrosion.....	Pass	Pass	Pass	Pass
Water and sediment	None	Trace	Trace	Trace

A fuel should be judged by its performance in the burner in which it is used. Approximately 80% of domestic central heating installations utilize pressure atomizing or gun-type burners with forced draft air supply. These burners have been found relatively insensitive to changes in fuels as long as fuels of the proper grade were utilized. Adjustments of air supply or nozzle placement sometimes are necessary, but these burners are designed with sufficient flexibility to allow satisfactory operation on either straight run or catalytically cracked fuels.

Vaporizing Burners

The majority of the remainder of domestic central heating installations and practically all of the space heaters are vaporizing, natural draft, pot-type burners. These, according to some authorities, constitute about 50% of all burners.

The vaporizing, pot-type burner with which heating engineers hitherto had only a slight contact (as relatively few pots have been used in central heating installations) has proven rather sensitive to catalytically cracked fuels. Some of the larger, more versatile models have been found to be acceptable, if certain limitations to be discussed later are kept in mind. Cooperative work of burner and oil industries is rapidly leading to new, acceptable designs capable of burning catalytically cracked fuels satisfactorily. It is hoped these will be placed on the market in the near future.

This is of great interest to the heating engineer because the new construction shows a long term trend toward smaller housing units. This indicates an increasing demand for smaller central heating installations. Both the decrease in the size of the individual house, due to the rapidly mounting cost of building, and the progress made in the reduction of heat losses through proper insulating procedures, result in greatly reduced heat requirements for an average home. Overall, this indicates that the new construction is more likely to require pot-type burners with but little competition from the gun burners. The reason for this is the lack of overlap in the operating ranges of the two types, the maximum heat outputs of the pot burners being of the same magnitude as the minimum heat output of the gun burners.

Performance

Vaporizing, pot-type burners may be classified into two general groups, those which are approved for kerosene or No. 1 fuel, and those which are also approved for heavier grades. Experience has shown that the former must be operated on light straight run distillates or not at all. It is in the latter class, however, that most of the operating difficulties with catalytically cracked fuels have arisen. In vaporizing, pot-type burners, the fuel is vaporized from the flat metal bottom of the pot. Air is drawn in through

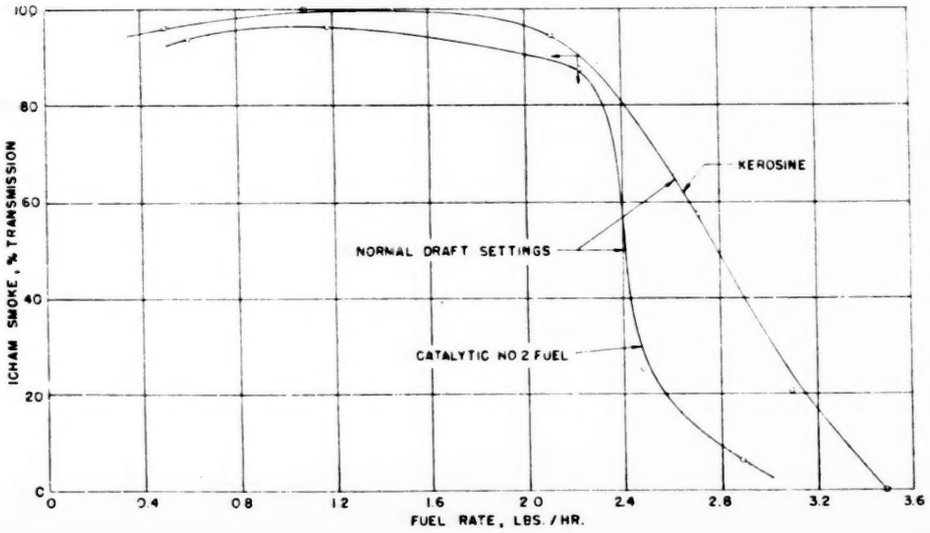
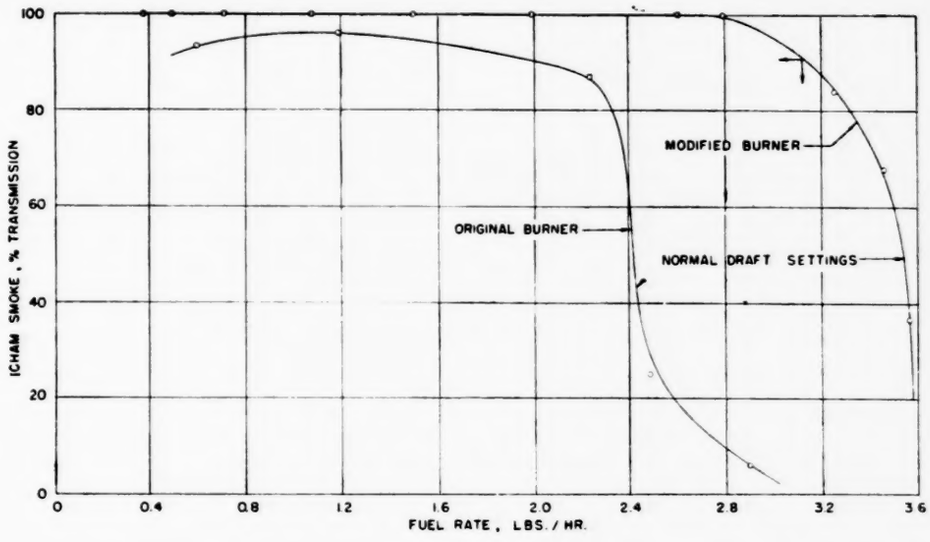


Fig. 1. Performance curves on a typical pot burner.

Fig. 2. **Performance curves on pot burners using catalytic fuels.**



holes along the sides of the pot by natural draft. With current designs, catalytically cracked No. 2 fuels are more sensitive than straight run fuels to vaporizing and mixing conditions. Excessive bottom temperatures lead to coke and hard carbon formation in the pot, while prevalent poor air-fuel mixing conditions cause soot formation, thus necessitating better air distribution. For these reasons, burners which are rated as suitable for heavier fuels usually cannot operate above 80% of their rated outputs with catalytically cracked fuels. Performance curves for a typical pot-type burner showing the difference between straight run catalytically cracked fuels are given in Fig. 1.

Burner Selection

In selecting a burner at the present time, there are a number of factors to be considered. If kerosene is available, almost any burner of the correct output will be satisfactory. When there is a reason to believe that No. 2 fuel will be used, the burner must be approved for No. 2 fuel. Even then, the burner will not reach rated capacity without objectionable soot formation and carbon deposition, and should be oversize to perform satisfactorily. Moreover, the frequency of cleaning out the burner will be higher, and some attention should be paid to choosing a burner which is easy to dismantle or accessible for cleaning.

The future for pot-type burners is much more encouraging than the present picture indicates. By adjusting the vaporizing temperatures and redesigning the air distribution baffles, present day burners have been modified to give performance on 100% catalytically cracked No. 2 fuels at least equal to that obtained in the original burners with kerosene. These data are shown in Fig. 2. In both figures ICHAM is the abbreviation of Institute of Cooking and Heating Appliance Manufacturers.

The principles upon which such modifications were based have been given to the burner industry. There is every reason to believe that continued cooperation of the burner and oil industries will lead to an early appearance of pot-type burners which are quite capable of burning catalytically cracked No. 2 fuels satisfactorily throughout their operating range up to the rated capacity.

To summarize, the change to catalytically cracked fuels does not really affect the heating engineer, except by influencing his choice as to the proper burner for the given job. It does, however, influence the burner manufacturer in that it affects the design of the burner. In case of gun-type burners, the customer is already enjoying the economies afforded by catalytically cracked fuels in that he is able to purchase more Btu per gallon of fuel at substantially the same cost per gallon. Further, it is probable that with the vaporizing, pot-type burner, the customer will soon be able to do the same with utmost satisfaction as to performance of his installation.

Fuel oils, whether straight run or catalytically cracked, are composed of the same basic compounds. The differences lie in the relative amounts of each component. The familiar prewar straight run fuels are composed mainly of paraffinic and naphthenic hydrocarbons which are high in hydrogen, and usually contain only small amounts of olefins and aromatics. If thermally cracked stocks are included, the olefin content is appreciably increased. Catalytically cracked fuels differ from previous fuels largely in the concentration of aromatics, which are formed during the catalytic cracking process. This difference in composition accounts for the change in physical as well as chemical characteristics of fuels. In the following tables are shown the analysis of four fuels: kerosene, which is a light straight run fuel, a straight run No. 2 fuel, a 100% catalytically cracked No. 2 fuel, and a current type of No. 2 fuel which is a mixture of straight run and catalytically cracked stocks.

Aromatic hydrocarbons contain rings of six carbon atoms and are low in hydrogen content. Both factors contribute to the low API gravity of the oil. In general, catalytically cracked fuels show very little difference in physical properties when compared to straight run fuels of the same boiling range. These differences show up mainly as lower gravities and pour points. Catalytically cracked fuels are also usually more highly colored than straight run fuels.

Normal (Average) Monthly and Seasonal Degree Days (65F Base) for 209 Cities

(Figures which follow are as compiled and issued by the Division of Climatological and Hydrologic Services, Industrial Section, U. S. Weather Bureau, in 1946. Unless otherwise indicated in the footnotes at end of table, these normals are for the 48 heating seasons beginning 1898-99 and ending 1945-46).

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
ALABAMA													
Anniston[1]	0	0	10	135	388	600	609	513	361	152	37	1	2806
Birmingham	0	1	10	111	348	586	591	497	313	130	23	1	2611
Mobile	0	0	1	44	203	377	397	314	175	52	3	0	1566
Montgomery	0	0	4	71	279	484	494	405	239	85	10	0	2071
ARIZONA													
Flagstaff[2]	43	70	244	573	847	1111	1167	970	889	668	469	190	7241
Phoenix	0	0	0	18	166	384	402	263	154	47	7	0	1441
Yuma[3]	0	0	0	9	113	306	318	182	85	22	1	0	1036
ARKANSAS													
Bentonville[4]	1	1	38	216	516	810	879	716	519	247	86	7	4036
Fort Smith	0	0	12	128	410	717	763	615	390	154	36	1	3226
Little Rock	0	0	11	120	383	668	704	579	367	145	31	1	3009
CALIFORNIA													
Eureka	281	269	274	344	411	518	541	478	504	440	391	307	4758
Fresno	0	0	5	77	309	562	573	380	289	152	52	4	2403
Independence[3]	0	0	28	216	512	778	799	619	477	267	120	18	3834
Los Angeles	1	0	5	43	110	225	272	235	212	158	103	27	1391
Needles[5]	0	0	0	19	217	416	447	243	124	26	3	0	1495
Point Reyes[3]	350	336	263	282	317	465	467	406	437	413	415	363	4474
Red Bluff[6]	0	0	12	97	345	592	601	419	328	178	72	9	2653
Sacramento	2	1	15	98	332	582	595	405	326	202	101	21	2680
San Diego	5	1	9	60	143	252	300	257	230	172	118	49	1596
San Francisco	196	179	121	139	241	420	460	340	317	272	255	197	3137
San Jose[4]	21	21	52	151	329	512	527	383	339	249	167	72	2823
COLORADO													
Denver	8	8	126	411	716	1005	1023	897	790	516	275	64	5839
Durango[7]	25	37	201	535	861	1204	1271	1002	859	615	394	139	7143
Grand Junction	1	1	59	347	743	1138	1218	883	671	377	152	23	5613
Leadville[8]	280	332	509	841	1139	1413	1470	1285	1245	990	740	434	10678
Pueblo	3	4	91	377	730	1042	1042	875	724	446	195	29	5558
CONNECTICUT													
Hartford[9]	3	16	105	370	692	1065	1157	1062	859	524	213	47	6113
New Haven	3	11	88	341	658	1017	1109	1023	840	522	221	47	5880
DISTRICT OF COLUMBIA													
Washington	0	2	42	251	553	872	928	834	624	340	101	14	4561
FLORIDA													
Apalachicola[10]	0	0	1	23	154	300	323	252	159	38	2	0	1252
Jacksonville	0	0	0	25	144	294	302	244	131	42	3	0	1185
Key West	0	0	0	0	2	14	21	15	7	0	0	0	59
Miami	0	0	0	0	15	41	53	45	28	3	0	0	185
Pensacola	0	0	0	25	159	305	332	255	162	39	4	0	1281
Tampa	0	0	0	6	60	149	157	126	62	11	0	0	571
GEORGIA													
Atlanta	0	0	12	128	392	644	660	563	382	169	33	2	2985
Augusta	0	0	4	85	312	529	533	448	274	107	13	1	2306
Macon[11]	0	0	5	91	322	532	538	449	278	108	14	1	2338
Savannah	0	0	1	45	206	390	395	332	194	66	6	0	1635
Thomasville[1]	0	0	2	48	208	361	359	299	178	52	5	1	1513
IDAHO													
Boise	9	17	136	385	717	1025	1077	840	688	440	252	92	5678
Lewistown[12]	5	9	107	378	688	932	992	779	603	371	193	52	5109
Pocatello	12	21	176	475	821	1159	1224	1004	845	550	330	124	6741
ILLINOIS													
Cairo	0	0	26	181	493	823	878	748	512	232	60	4	3957
Chicago	6	7	88	337	712	1116	1218	1080	861	531	259	67	6282
Peoria[13]	4	8	88	350	730	1126	1231	1035	790	436	178	28	6004
Springfield	0	3	65	286	664	1056	1151	977	719	377	132	16	5446
INDIANA													
Evansville	0	1	35	211	544	888	948	822	582	288	85	6	4410
Fort Wayne[14]	6	13	106	374	737	1107	1211	1052	864	504	217	41	6232
Indianapolis	1	4	66	297	660	1032	1102	973	737	410	154	22	5458
Royal Center[15]	11	19	116	373	740	1104	1239	976	860	502	245	54	6239
Terre Haute[16]	0	3	62	270	627	993	1072	897	687	358	133	15	5117
IOWA													
Charles City[9]	8	24	164	480	906	1362	1535	1281	995	552	255	62	7624
Davenport	2	6	91	344	748	1176	1291	1111	835	448	171	29	6252
Des Moines	1	6	102	354	767	1204	1320	1132	843	446	171	29	6378
Dubuque	3	12	123	402	808	1249	1380	1190	915	493	204	41	6820
Keokuk[17]	1	3	71	303	680	1077	1191	1025	761	397	136	18	5663
Sioux City	3	11	128	402	844	1273	1402	1206	909	485	202	40	6905

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
KANSAS													
Concordia	1	3	68	288	670	1060	1144	954	712	365	142	18	5425
Dodge City	1	3	59	275	641	998	1046	868	668	351	139	20	5069
Iola[1]	0	1	40	236	579	930	1026	817	599	282	98	8	4616
Topeka	0	2	56	254	623	1013	1096	917	659	326	116	13	5075
Wichita	0	1	41	221	576	947	1016	836	604	290	103	9	4644
KENTUCKY													
Louisville	0	1	35	217	549	881	931	816	588	298	93	8	4417
Lexington[3]	1	3	48	258	601	916	964	862	650	352	123	14	4792
LOUISIANA													
New Orleans	0	0	0	23	145	304	323	247	129	31	1	0	1203
Shreveport	0	0	4	71	275	506	531	415	241	79	10	0	2132
MAINE													
Eastport	158	146	271	528	827	1224	1364	1238	1080	778	530	301	8445
Greenville[18]	69	113	315	643	1012	1464	1625	1443	1251	842	468	194	9439
Portland	28	48	182	466	794	1182	1309	1188	997	671	376	136	7377
MARYLAND													
Baltimore	0	1	33	227	526	855	921	837	637	343	95	12	4487
MASSACHUSETTS													
Boston	7	15	98	338	647	1008	1108	1025	841	538	245	66	5936
Fitchburg[2]	12	29	144	432	774	1139	1240	1137	940	572	254	70	6743
Nantucket	15	15	87	315	590	904	1010	967	866	619	366	121	5875
MICHIGAN													
Alpena	53	79	235	548	874	1238	1388	1321	1162	764	448	168	8278
Detroit	7	15	111	388	749	1124	1230	1134	927	566	253	56	6560
Escanaba	54	84	256	572	927	1329	1499	1382	1219	808	477	170	8777
Grand Rapids[19]	8	20	128	422	764	1136	1248	1143	944	569	263	57	6702
Houghton[20]	70	94	268	582	965	1355	1535	1421	1251	820	474	195	9030
Lansing[21]	18	36	167	467	818	1190	1306	1178	995	600	294	80	7149
Ludington[22]	41	55	182	472	794	1135	1271	1183	1056	698	418	153	7458
Marquette	86	99	258	555	926	1306	1465	1349	1193	794	494	220	8745
Sault Ste. Marie	91	110	285	616	965	1379	1572	1470	1291	826	487	215	9307
MINNESOTA													
Duluth	80	97	292	631	1066	1539	1714	1497	1254	804	515	234	9723
Minneapolis	8	23	167	481	942	1415	1587	1372	1072	577	260	62	7966
Moorhead[2]	20	47	240	607	1105	1609	1815	1555	1225	679	327	98	9327
St. Paul[23]	11	24	169	488	942	1412	1589	1371	1078	573	258	60	7975
MISSISSIPPI													
Corinth[24]	0	1	13	142	418	669	696	570	396	149	32	1	3087
Meridian[25]	0	0	6	99	322	525	539	440	274	107	17	1	2330
Vicksburg	0	0	5	76	267	483	503	407	236	82	10	0	2069
MISSOURI													
Columbia	0	3	62	266	621	1000	1076	916	655	337	120	14	5070
Hannibal[3]	1	3	66	288	652	1037	1139	980	710	374	128	15	5393
Kansas City	0	2	51	239	598	993	1077	909	651	322	108	12	4962
Saint Louis	0	1	38	215	558	925	998	855	607	300	91	8	4596
Springfield	1	2	48	232	561	908	971	827	596	302	109	12	4569
MONTANA													
Billings[26]	14	31	223	530	889	1215	1310	1102	923	555	315	106	7213
Havre	27	54	275	592	1012	1376	1532	1358	1102	614	341	133	8416
Helena	43	66	291	596	944	1252	1347	1157	990	639	413	192	7930
Kalispell[11]	66	102	332	636	968	1235	1339	1135	956	630	413	220	8032
Miles City	7	20	188	510	918	1322	1461	1267	997	545	275	81	7591
NEBRASKA													
Drexel[27]	4	6	95	405	788	1271	1353	1096	843	493	219	38	6611
Lincoln	1	5	85	325	732	1144	1242	1056	792	407	166	25	5980
North Platte	4	9	131	410	799	1163	1227	1039	846	480	227	49	6384
Omaha	1	4	84	324	744	1169	1280	1088	810	410	157	24	6095
Valentine	8	19	167	479	877	1246	1349	1166	962	563	287	74	7197
NEVADA													
Reno[28]	8	18	140	407	697	959	1007	791	702	498	301	93	5621
Tonopah[29]	5	7	105	388	713	1010	1075	870	749	522	286	82	5812
Winnemucca	10	23	188	494	801	1090	1128	884	768	536	321	114	6357
NEW HAMPSHIRE													
Concord[19]	18	49	189	497	823	1228	1345	1213	993	637	308	100	7400
NEW JERSEY													
Atlantic City	1	2	39	247	546	867	946	887	750	485	208	37	5015
Cape May[30]	1	2	38	221	527	852	936	876	737	459	188	33	4870
Newark[31]	1	6	65	295	635	980	1083	1002	794	448	162	29	5500
Sandy Hook[32]	1	2	40	268	579	921	1016	973	833	499	206	31	5369
Trenton[33]	1	6	63	301	604	957	1033	923	748	441	154	25	5256
NEW MEXICO													
Albuquerque[34]	0	0	27	258	646	913	955	708	592	322	91	5	4517
Roswell[28]	0	0	26	191	512	781	773	585	459	199	50	2	3578
Santa Fe	12	15	129	451	772	1071	1094	892	786	544	297	60	6123
NEW YORK													
Albany	4	15	117	411	753	1143	1271	1169	948	551	220	46	6648
Binghamton	15	37	148	448	767	1137	1236	1155	950	584	267	74	6818
Buffalo	15	24	126	413	745	1110	1226	1165	995	668	348	90	6925
Canton[35]	27	61	219	550	898	1368	1516	1385	1139	695	340	107	8305
Ithaca[36]	17	40	156	451	770	1129	1236	1156	978	606	292	83	6914
New York	1	4	50	272	594	940	1028	953	771	465	172	30	5280
Oswego	20	33	147	440	762	1151	1275	1188	1015	665	366	124	7186
Rochester	10	26	132	423	751	1123	1227	1155	967	605	282	71	6772
Syracuse[19]	13	32	146	437	760	1147	1255	1167	972	611	283	76	6899

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
NORTH CAROLINA													
Asheville[37]	2	3	49	279	565	800	817	719	558	315	114	15	4236
Charlotte	0	1	17	148	420	684	700	600	413	198	39	4	3224
Hatteras	0	0	1	61	273	500	570	530	391	193	34	1	2554
Manteo[38]	0	0	7	113	358	595	642	594	469	249	75	7	3109
Raleigh	0	1	17	153	415	681	702	615	429	210	46	6	3275
Wilmington	0	0	5	90	306	520	531	479	320	144	24	1	2420
NORTH DAKOTA													
Bismarck	21	44	244	595	1057	1520	1704	1479	1181	643	340	109	8937
Devils Lake[9]	42	76	295	687	1186	1676	1906	1615	1313	752	411	145	10104
Grand Forks[39]	32	60	274	663	1160	1681	1895	1608	1298	718	359	123	9871
Williston	28	61	285	637	1104	1545	1733	1513	1226	671	368	130	9301
OHIO													
Cincinnati	1	3	53	273	611	960	1008	898	668	369	130	16	4990
Cleveland	7	14	93	354	684	1045	1143	1067	876	553	252	56	6144
Columbus	2	6	68	314	670	1019	1081	975	749	432	165	25	5506
Dayton[40]	2	6	71	309	660	992	1079	939	752	416	163	23	5412
Sandusky	3	8	82	347	695	1067	1155	1066	862	536	232	42	6095
Toledo	5	13	100	370	718	1097	1189	1083	887	533	227	47	6269
OKLAHOMA													
Broken Arrow[41]	0	0	28	169	513	805	881	646	506	212	61	5	3826
Oklahoma City	0	0	22	153	455	792	846	684	457	200	58	3	3670
OREGON													
Baker	54	72	259	534	848	1161	1222	984	827	601	418	217	7197
Medford[42]	7	10	99	345	632	837	844	636	556	387	223	74	4650
Portland	27	28	106	292	538	725	775	616	533	368	237	108	4353
Roseburg	23	26	116	316	541	714	730	582	530	386	257	111	4332
PENNSYLVANIA													
Erie	8	17	101	367	692	1049	1159	1105	922	591	284	68	6363
Harrisburg	1	6	67	314	637	990	1073	973	757	425	146	23	5412
Philadelphia	0	2	36	235	544	884	962	881	685	378	115	17	4739
Pittsburgh	3	7	69	322	651	982	1042	964	751	444	166	29	5430
Reading[16]	1	5	69	301	606	957	1038	929	736	423	144	23	5232
Scranton[25]	6	22	117	400	717	1074	1162	1071	862	523	213	51	6218
RHODE ISLAND													
Block Island	10	11	79	313	596	919	1030	984	875	618	354	108	5897
Narragansett Pier[43]	1	26	121	366	691	1012	1113	1074	916	622	342	113	6397
Providence[9]	6	16	101	358	668	1020	1106	1027	847	538	237	60	5984
SOUTH CAROLINA													
Charleston	0	0	1	47	225	428	452	384	239	83	7	0	1866
Columbia	0	0	6	95	327	560	568	482	305	126	18	1	2488
Due West[44]	0	0	9	142	393	594	651	491	411	158	39	2	2890
Greenville[45]	0	1	13	127	410	650	684	551	403	179	40	1	3059
SOUTH DAKOTA													
Huron	10	20	159	502	962	1409	1572	1353	1039	573	271	70	7940
Pierre[46]	4	11	136	438	887	1317	1460	1253	971	516	238	52	7283
Rapid City	15	28	192	495	842	1178	1280	1140	981	598	339	109	7197
TENNESSEE													
Chattanooga	0	0	13	150	432	691	711	604	412	185	39	1	3238
Knoxville	0	0	20	189	498	756	774	666	470	226	56	3	3665
Memphis	0	0	14	126	387	670	716	600	386	157	33	1	3090
Nashville	0	0	20	170	469	748	788	675	467	218	55	3	3613
TEXAS													
Abilene	0	0	10	96	332	603	619	483	296	110	23	1	2573
Amarillo	1	2	42	221	548	854	861	719	546	284	107	11	4196
Austin[47]	0	0	2	31	227	410	458	315	185	46	5	0	1679
Brownsville[48]	0	0	0	8	65	176	191	111	65	11	1	0	628
Corpus Christi	0	0	0	11	102	255	282	204	93	17	1	0	965
Dallas[30]	0	0	6	70	293	574	600	437	281	91	15	0	2367
Del Rio[13]	0	0	2	35	203	413	413	262	139	31	3	0	1501
El Paso	0	0	6	88	366	615	615	432	291	104	14	1	2532
Fort Worth	0	0	5	79	285	553	586	463	270	97	16	1	2355
Galveston	0	0	0	14	123	290	334	255	130	27	1	0	1174
Houston[26]	0	0	1	27	160	331	361	247	150	36	2	0	1315
Palestine	0	0	4	67	261	496	512	401	236	80	11	0	2068
Point Arthur[49]	0	0	1	27	177	328	375	254	191	37	2	0	1352
San Antonio	0	0	1	31	171	366	390	287	148	37	4	0	1435
Taylor[40]	0	0	2	56	234	462	494	375	214	64	8	0	1909
UTAH													
Modena[23]	6	11	156	499	832	1142	1190	944	816	567	338	97	6598
Salt Lake City	3	5	98	371	712	1033	1093	871	716	446	236	66	5650
VERMONT													
Burlington[35]	23	51	209	530	870	1313	1467	1338	1111	694	399	106	8111
Northfield[50]	62	112	283	602	947	1389	1524	1384	1176	754	405	166	8804
VIRGINIA													
Cape Henry	0	0	7	125	398	676	731	682	526	301	86	6	3538
Lynchburg	1	2	37	230	521	799	829	732	537	287	81	12	4068
Norfolk	0	0	9	129	392	668	712	650	483	254	62	5	3364
Richmond	0	1	27	196	486	780	814	722	538	278	72	8	3922
Wytheville[51]	7	13	82	352	662	916	945	836	677	410	168	35	5103
WASHINGTON													
North Head[37]	251	229	255	350	491	642	697	597	610	505	428	312	5367
Seattle	67	69	170	365	554	704	759	637	595	436	299	160	4815
Spokane	20	37	184	480	817	1061	1139	931	756	490	285	118	6318
Tacoma	71	75	190	390	581	737	786	658	612	455	313	171	5039
Tatoosh Island	301	295	325	421	534	654	716	627	643	537	454	350	5857
Walla Walla	5	10	90	315	662	910	981	770	571	354	186	56	4915
Yakima[26]	8	17	124	395	778	1050	1125	837	624	374	193	60	5585

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
WEST VIRGINIA													
Elkins	15	23	115	403	722	1003	1033	947	763	489	229	58	5800
Parkersburg	1	3	56	286	617	930	977	882	660	369	129	18	4928
WISCONSIN													
Green Bay	17	38	179	494	889	1329	1493	1329	1087	658	327	91	7931
Le Crosse	7	22	157	454	864	1339	1492	1281	990	531	232	52	7421
Madison[9]	8	20	145	452	857	1296	1451	1246	1002	588	274	66	7405
Milwaukee	13	17	124	411	786	1203	1329	1177	959	617	341	102	7079
Wausau[32]	26	58	216	568	982	1427	1594	1381	1147	680.	315	100	8494
WYOMING													
Cheyenne	40	46	251	587	876	1144	1187	1064	996	720	460	165	7536
Lander	27	43	265	623	1021	1400	1427	1197	1006	669	410	155	8243
Yellowstone Park[7]	125	173	424	759	1079	1386	1464	1252	1165	841	603	334	9605

[1]36 seasons, 1905-06 to 1940-41. [2]43 seasons, 1898-99 to 1940-41. [3]44 seasons, 1898-99 to 1940-41, 1945-46. [4]35 seasons, 1906-07 to 1940-41. [5]22 seasons, 1917-18 to 1938-39. [6]41 seasons, 1898-99 to 1933-34, 1938-39 to 1940-41, 1944-45 to 1945-46. [7]37 seasons, 1904-05 to 1940-41. [8]34 seasons, 1907-08 to 1940-41. [9]42 seasons, 1904-05 to 1945-46. [10]33 seasons, 1913-14 to 1945-46. [11]47 seasons, 1899-1900 to 1945-46. [12]33 seasons, 1900-01 to 1932-33. [13]41 seasons, 1905-06 to 1945-46. [14]35 seasons, 1911-12 to 1945-46. [15]14 seasons, 1918-19 to 1931-32. [16]34 seasons, 1912-13 to 1945-46. [17]44seasons, 1898-98 to 1941-42. [18]38 seasons, 1907-08 to 1940-41, 1942-43 to 1945-46. [19]43 seasons, 1903-04 to 1945-46. [20]45 seasons, 1900-01 to 1940-41, 1942-43 to 1945-46. [21]36 seasons, 1910-11 to 1945-46. [22]29 seasons, 1912-13 to 1940-41. [23]39 seasons, 1898-99 to 1932-33, 1937-38 to 1940-41. [24]32 seasons, 1909-10 to 1940-41. [25]46 seasons, 1900-01 to 1945-46. [26]37 seasons, 1909-10 to 1945-46. [27]11 seasons, 1915-16 to 1925-26. [28]41 seasons, 1905-06 to 1945-46. [29]27 seasons, 1914-15 to 1940-41. [30]34 seasons, 1898-99 to 1931-32. [31]32 seasons, 1898-99 to 1923-24, 1935-36 to 1940-41. [32]26 seasons, 1915-16 to 1940-41. [33]32 seasons, 1914-15 to 1945-46. [34]27 seasons, 1919-20 to 1945-46. [35]40 seasons, 1906-07 to 1945-46. [36]44 seasons, 1899-1900 to 1942-43. [37]44 seasons, 1902-03 to 1945-46. [38]25 seasons, 1904-05 to 1928-29. [39]33 seasons, 1912-13 to 1940-41, 1942-43 to 1945-46. [40]33 seasons, 1911-12 to 1942-43, 1945-46. [41]13 seasons, 1918-19 to 1930-31. [42]31 seasons, 1911-12 to 1940-41, 1945-46. [43]20 seasons, 1898-99 to 1917-18. [44]11 seasons, 1921-22 to 1931-32. [45]29 seasons, 1917-18 to 1945-46. [46]47 seasons, 1898-99 to 1940-41, 1942-43 to 1945-46. [47]20 seasons, 1926-27 to 1945-46. [48]38 seasons, 1908-09 to 1945-46. [49]40 seasons, 1901-02 to 1940-41. [50]45 seasons, 1898-99 to 1942-43. [51]39 seasons, 1902-03 to 1940-41.

2000 HP Gas Turbine Generator Set

An experimental 2,000-hp gas turbine generator set that weighs only 19 lb per hp and starts in 1½ minutes or less has been developed by Westinghouse Electric Corp. for industrial and other applications. It was described by Thomas J. Putz, manager of the Westinghouse Gas and Locomotive Turbine Section before the annual meeting of the ASME.

Burning No. 6 fuel oil to compensate economically for an expected thermal efficiency of its simple open cycle of 20% at full load, the gas turbine generator set operates at a top temperature of 1350F—the maximum practical temperature using currently available materials without resort to cooling. The simplest type of open cycle, consisting of only a compressor, combustor and turbine is employed in order that operating experience on these major components may be most quickly acquired, and the useful output is absorbed by a double-armature d-c traction-type generator connected to the turbine through a single reduction gear.

In operation, air is taken in by the compressor through the inlet metering nozzle and silencer and compressed to pressures of 30 to 75 lb. per sq. in. absolute, depending on the load carried. Fuel oil is mixed with the compressed air and burned in the combustors, the amount of fuel burned being controlled to limit the temperature of the gases to between 700 and 1350F at the combustion chamber outlets. The hot gases are expanded through the power-producing turbine and the resultant exhaust gases pass through a diffuser, elbow, and silencer to the atmosphere.

The turbine develops approximately 6000 hp, of which 4,000 hp is used to drive the compressor. The remaining 2,000 horsepower is the useful output delivered to the d-c generator. The full load speed of the turbine and compressor is 9,200 rpm while the generator speed is 1,200 rpm.

The compressor is of the axial flow type, designed to pass 25,000 cfm of air at a pressure ratio of 5 to 1. It has a maximum speed of 9,200 rpm and the pressure ratio is varied from 2:1 to 5:1, depending on the load carried, by changing the speed. It contains 20 stages of non-symmetric blading designed so that the major pressure rise occurs in the rotating blades. The latter have a constant tip diameter of 18⅜ in. and vary in height from 3 in. at the inlet to 1½ in. at the discharge. The blades are forged from 12% chromium steel stock similar to that used in steam turbine work. The serrated root fastening is machined in the base by using a formed milling cutter. The blades are caulked into serrated grooves cut in the rotor. Stationary blades are precision cast of 18-8 stainless steel and are caulked into grooves cut in the cylinder wall.

The air flow passes from the compressor through a diffuser where the velocity is reduced and transition is made from an annular passage to twelve circular passages. The diffuser is made of welded castings.

The gas turbine itself consists of eight stages designed for equal heat drop over the stationary and rotating blades at the mean diameter. The shaft seals used are all of the labyrinth type, and the journal bearings are of the pressure lubricated sleeve type.

The rotor is machined from a solid forging of stabilized 19-9 stainless steel, the main section being 14½ in. in diameter and 24 in. long. This was the largest forging ever made of this material at the time and a number were rejected in the beginning.

Coating For Air Duct Systems

PROTECTIVE coatings are necessary to prolong the life of ferrous metal ducts. They help to retard corrosion and to protect the metal when the ducts carry abrasive-laden air.

A relatively new protective coating is obtained by the use of neoprene synthetic rubber surfacing materials, or solutions of unvulcanized compositions of neoprene in suitable solvents. Films deposited from these solutions, when properly vulcanized, are said to be resistant to aging and oxidation, chemical fumes, solvent vapors and the eroding action of abrasive particles. The elastic properties of the films make the coating resistant to checking or cracking by expansion of a metal duct or accidental bending during installation of the duct. The film can withstand temperatures from —58 to 250F. The films are vulcanized or "cured" by application of heat at temperatures in excess of 210F and when so treated the adhesion between the metal and coating is greater than 1,000 lb per sq in.

Neoprene surfacing materials are available in two basic forms—one a brushing fluid or cement of a consistency approaching paint, and the other a putty-like product of a consistency suitable for application by trowel. Each of these products is generally packaged in two parts. One is a solvent solution of unvulcanized neoprene composition and the other a vulcanization accelerator which is added to both the brushing cement and the troweling composition just prior to use in order to fully develop the resilient properties of the coatings.

The material applied by brush is usually satisfactory for linings and exterior coatings of ducts when coatings up to 1/16 in. thickness are desired. The troweling mixture is used where thicker coatings are needed to offset abrasive action of the air carried in the ducts. The troweling putty is also used in conjunction with the brushing compound to cover lap joints, bolt heads, sharp edges and other surface irregularities which may be difficult to protect by the thinner brushing applications. Troweled coatings can also be used to cover the flange faces of duct sections to act as integral gaskets which will then form a tight resilient seal.

Method of Application

The following steps in application procedure must be followed to obtain the best results when using neoprene surfacing materials:

(1) Preparation of the metal surface.
(2) Priming of surface.
(3) Preparation of accelerated surfacing materials.
(4) Application by brushing or troweling.

Neoprene-coated impeller for corrosive service.

(5) Drying of the coats.
(6) Vulcanization of the neoprene coating.

(1) Surfaces to be coated must be clean, dry and free from oil, grease or other contaminating substances. When coating metal which is to be exposed to dynamic service, sand or grit blasting is the only method recommended for preparation of the surface. For exterior coatings where only vapors at ordinary temperatures are to be encountered, scraping or wire-brushing may be used.

(2) Freshly cleaned metal surfaces are coated with an adhesive base coat or primer. An even coating of the primer is necessary to obtain uniform adhesion.

(3) The vulcanizing accelerator is stirred or troweled into the coating composition. Since the addition of the vulcanization accelerators lowers the stability of the mixtures, only a limited amount can be mixed at any one time. Some degree of control of the material's workability is possible by controlling the amount of accelerator that is added.

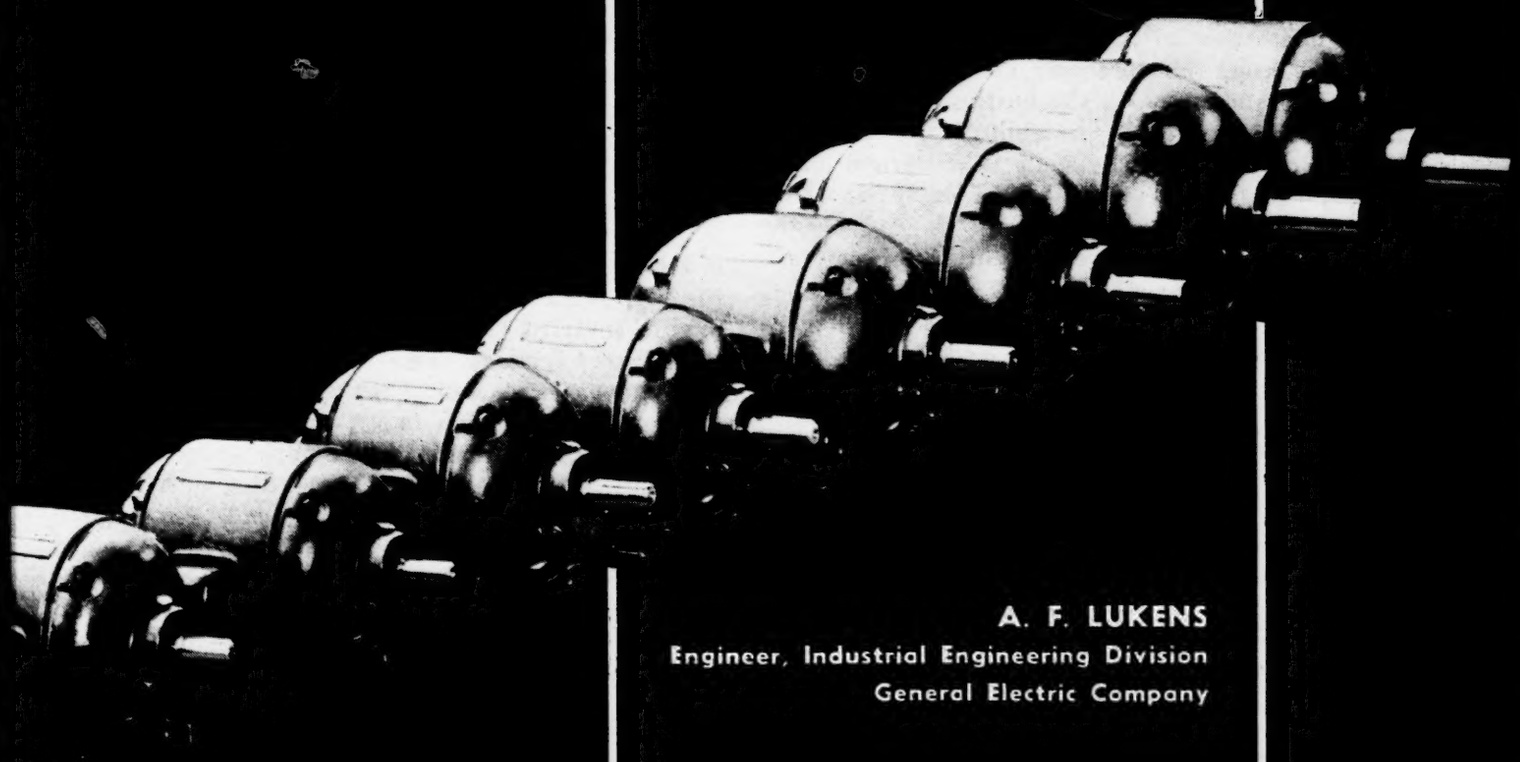
(4) The accelerated brushing cement or troweling composition is then applied by brush or trowel.

(5) After the lining has been applied, it is allowed to dry at temperatures at or slightly above 100F to insure that all the volatile solvent has evaporated.

(6) The final step is vulcanization at elevated temperatures to develop the elastic property of the finished coating.

Illustration and data were supplied by E. I. du Pont de Nemours and Co., and Gates Engineering Co., Wilmington, Del.

Selection of MEDIUM SIZE MOTORS



A. F. LUKENS
Engineer, Industrial Engineering Division
General Electric Company

HEATING AND VENTILATING'S
REFERENCE SECTION

Selection of Medium Size Motors

A. F. LUKENS
Engineer, Industrial Engineering Division,
General Electric Co., Lynn, Mass.

Discussion of the types of motors available for use in the heating, ventilating and air conditioning fields, and guides for the proper selection of 1 to 60 hp motors for such special service. Material is grouped both as to mechanical and electrical types, and as to industrial applications.

SELECTION of the proper motor for any job is of great importance to the three parties concerned: The ultimate user, the purchaser of the motor, and the motor manufacturer. In the heating, ventilating, and air conditioning fields, reliability is important because the comfort of individuals is concerned and standby equipment is seldom supplied except in the larger installations.

In the electrical industry the various types of motors and their modifications, both electrical and mechanical, are well standardized. Consequently, a selection of some standardized combination can usually be made to meet the requirements of this special field in the most economical manner. To study the matter, let us first consider the qualifications and peculiarities of the various types of motors, match these characteristics with the requirements of the machine or device that is to be driven, and then make the final selection.

Since it would be impossible to cover the whole of this great field in a single article, the greater part of this article will refer to medium size motors, 1 to 50 or 60 hp, with only a few references to the smaller fractional-horsepower sizes, and large motors. Likewise, only a selection of driven machines will be discussed.

The first thing to consider, and one over which the motor purchaser has little or no control, is the power supply. In the United States, the majority of services is 60-cycle alternating-current, either single-phase or polyphase. Standard voltages are 115 and 230 for single-phase, and 110, 208, 220, 440, 550, and 2,300 volts for polyphase lines. Direct-current is found in some sections of the older cities, in some large buildings that generate their own power, and on some isolated farm plants. The standard d-c voltages are 115 and 230. The type of power, a-c or d-c, the voltage, the frequency, and the number of phases, are a part of every motor specification and must be noted.

Enclosure

The enclosure of a motor refers to the arrangement of the ventilating openings or other means of cooling and the amount of protection provided against the atmosphere in which the motor operates. In the heating and ventilating field, motors of the open (drip-proof), totally enclosed, totally enclosed fan-cooled, and explosion-proof enclosures might be used.

The open motor is the basic standard and its ventilating openings do not protect the motor from dirt, water, or fumes. However, the present trend is to build such motors with considerable protection and in the case of many manufacturers, the open motor, Fig. 1, meets all the requirements of the drip-proof specification.

The drip-proof type is essentially an open motor with its ventilating openings arranged so that dripping water will not enter it. An elaboration of this type is the splash-proof motor, the openings of which offer further protection against splashing water. The latter usually carries a price premium of about 15% and is sometimes used in locations where splashing may occur followed by a period during which the motor can run in relatively dry air. The present trend is to use either the drip-proof or totally-enclosed motor, as dictated by the severity of the application, rather than the splash-proof type.

Totally-enclosed, and totally-enclosed fan-cooled motors, as their names imply, have no openings connecting the space around the windings with the outside air, and are generally used where dirt, dust, fumes, dampness, or outdoor conditions prevail. The smaller ratings are non-ventilated, while the larger ones are fan-cooled, Fig. 2, by an external fan which blows air over the outside of the motor case. The price is about 150% of the open motor price, but this is often offset by a lower maintenance cost.

Explosion-proof motors are totally-enclosed or totally-enclosed fan-cooled motors so designed that they will not produce an explosion when operated in the flammable atmosphere for which they are approved.

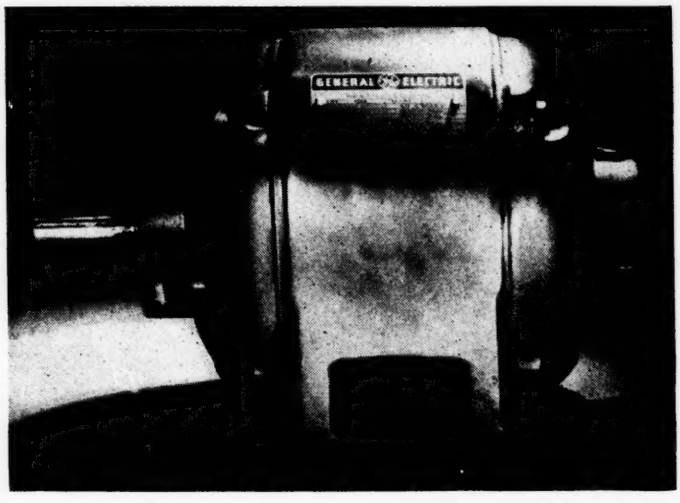


Fig. 1. Typical drip-proof, sleeve-bearing, induction motor.

They are designed, manufactured, and tested under the strict supervision of Underwriters' Laboratories, Inc. The price is about 180% of that of the open motor of the same rating.

Bearings

Bearings in these types of motors are either of the sleeve or rolling-contact type. Fractional-horsepower motors nearly universally use wool-packed sleeve bearings while the larger motors may have either sleeve, ball, or roller bearings. The larger sleeve-type bearings are lubricated with oil fed to the journal either by the capillary attraction of the wool waste or by a revolving oil ring, depending on the motor size and speed. Rolling contact bearings are usually of the ball type, but roller bearings, or a combination of ball and roller bearings, are sometimes used. If the motor is expected to carry some thrust load, at least one ball bearing or a tapered roller bearing is required unless some very special construction is used.

The pros and cons of ball versus sleeve bearings are legion, but some of the major points follow. Ball bearings will take thrust while the usual sleeve bearing will not. The ball-bearing motor is not so apt to have objectionable end bump of the rotor under pulsating load as a sleeve-bearing motor. A sleeve-bearing motor often has a lower price. A sleeve-bearing motor may be quieter, but this is by no means universally true. A ball bearing generally requires less frequent lubrication, but on the other hand it probably requires a higher degree of skill in lubrication.

Quietness

Certain types of motors are inherently noisier than others, but all commercial motors are reasonably quiet. Sometimes a special quiet motor is specified in the hope of reducing objectionable noise, but in the great majority of such cases the little gain that can be obtained from the special motor is of small consequence. It is better to provide some means of general noise suppression so that noise of the driven machine is reduced at the same time. On the other hand, poor running balance of the motor may be of considerable importance in producing noise.

In the special case of single-phase motors which have an inherent electrical unbalance, sound-isolating mountings may prove very effective. These are sometimes incorporated in the motor itself by the motor manufacturer, or supplied as an external device. Here, again, it may prove better to isolate a sub-base carrying the motor and the driven machine, rather than the motor alone.

The first broad division is by power supply which determines the basic kind of motor, a-c polyphase, a-c single phase, or d-c.

Induction Motors

The induction motor is the most common type of a-c polyphase motor. It is mechanically the simplest of all motors and consists of only a rotor, a stator, and two end-shields with the bearings. It is essentially a constant-speed machine, which means that the speed changes very little with load and cannot be adjusted. Induction motors are classified by starting-torque,

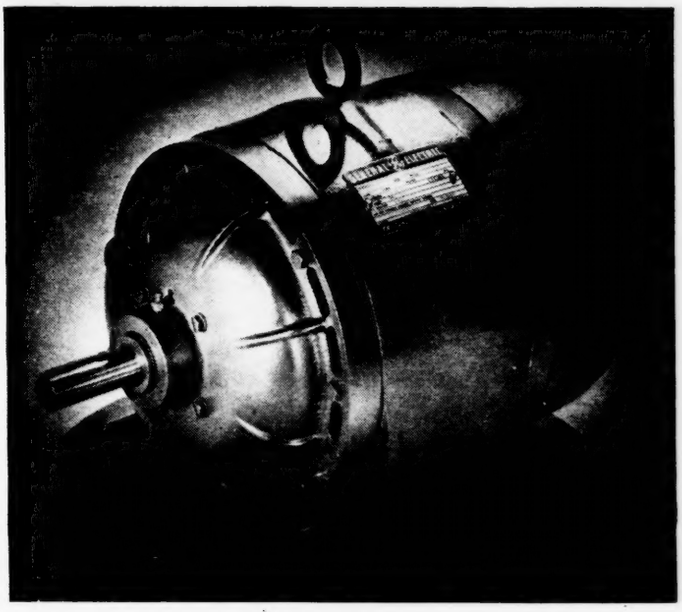


Fig. 2. Typical, totally enclosed, fan cooled, ball bearing, induction motor.

locked-rotor current, and full-load speed. The National Electrical Manufacturers Association Standards classify squirrel-cage induction motors thus:

Class A. Normal starting torque—normal starting current.

Class B. Normal starting torque—low starting current.

Class C. High starting torque—low starting current.

Class D. High slip.

Normal starting torque, listed in the standards as being more than 150% for four poles is usually in the 180% to 225% range for the smaller motors, and is sufficient to start the majority of loads. High starting torque motors usually have a minimum of about 225% starting torque. Fig. 3 shows typical speed-torque curves of the three common classes of induction motors.

Class A motors are not commonly found at the present time, and Class B motors are used unless the extra starting torque of the Class C motor is required by the application.

Class B motors usually have in excess of 200% breakdown torque, while the Class C motors have slightly less. Breakdown torque is the greatest torque that the motor will carry at full voltage without a sudden change in speed. However, the maximum peak of the load torque should not exceed two-thirds or three-quarters of the value of the breakdown torque.

Standard induction motors may, at the manufacturers' discretion, carry a service factor which defines the additional load that the motor will carry without reaching a temperature that will cause undue shortness of insulation life. For open and some drip-proof motors this factor is 1.15. This means that the motor will carry 15% more horsepower than stamped on the nameplate. This 15% can be used as a safety factory to take care of the unknown things that may cause overloading of the motor, or if the load is known with considerable certainty, this extra output of the machine can be used under normal conditions. Splash-proof and totally-enclosed types of motors normally do not carry

a service factor greater than 1.00, so when one of these motors is used on an application that normally uses an open motor, care must be exercised to see that the motor is not overloaded to a dangerous extent.

In this connection, it must be remembered that the overload device will remove the motor from the line when conditions for which it is set are reached. The National Electrical Code specifies what these conditions should be, and most wiring inspectors abide by the code rules. The usual overload device mounted in the controller case must remove the motor from the line if the current exceeds 125% of full load current in a 40C (104F) ambient temperature. These devices are usually made so that the motor will carry a greater load in a lower ambient temperature, and will allow the motor to maintain approximately the same total temperature.

Since 40C is not uncommon in many locations, especially in the summer, and since there must always be some leeway in the effective capacity of the motor, these rules rather effectively limit the maximum expected load on the motor to the service factor rating of the motor. In certain cases where the load is accurately known, both in horsepower and in time, it is possible to trade on the time lag of the overload device and allow the motor to carry an overload for a short period of time. However, there is always the chance that something minor will go wrong which would unnecessarily shut down the machine.

When a motor mounted overload protective device is used, the time-temperature overload characteristics of the combination of motor and control are better known, and it is much safer to allow short time overloads on the motor without fear of interrupted service.

Wound Rotor Induction Motors

Wound-rotor induction motors are similar to squirrel-cage induction motors except that the rotor has an insulated winding with collector rings, between which resistance can be inserted to vary the characteristics. They are little used in the heating and ventilating field and then usually in large installations where the power supply is limited. Their detailed characteristics will not be further considered.

Synchronous Motors

Synchronous motors are used primarily in the larger sizes to capitalize on their ability to modify and better the power factor of the line. Since their application is rather limited, the only facts that will be mentioned are that the starting torque is low and that the combination of the WR^2 and the torque pulsations of the load are of great importance.

No practical single-phase motor has yet been invented that has the simplicity of the polyphase induction motor, and all single-phase motors have some extra device to make them start. This is either integrally mounted or supplied as an external part. Great ingenuity has been shown by designers and manufacturers in making simple and rugged devices. However, the fact remains that single-phase motors are more expensive and more complicated than polyphase induction motors and, therefore, should be used only when polyphase power is not available. A possible exception is in the fractional-horsepower field where the driven devices are small and are apt to be of less importance. In this case, the expense of three-phase wiring and switches outweighs the other consideration.

There are three general types of single-phase motors on the market at the present time, the repulsion-start induction-run motor, the repulsion-induction motor, and the capacitor motor. Each manufacturer has his own variation of the circuits and the mechanical devices used in the motor, so only broad general statements can be made about each type.

Repulsion-Start, Induction-Run Motors

Repulsion-start, induction-run motors have a laminated stator with one set of coils per pole to make a single-phase winding. The armature has a wire-wound winding and a commutator very similar to a d-c machine. Brushes are short circuited together rather than connected to the line, so that the armature winding is excited by induction. A commutator short-circuit device is supplied that connects all the commutator bars, and in some cases, raises the brushes when the rotor reaches a predetermined speed. This transforms the armature into a squirrel-cage rotor, in effect, so that the motor then runs as a single-phase induction motor. Fig. 4 shows a typical speed-torque curve.

This type of motor is characterized by a very high

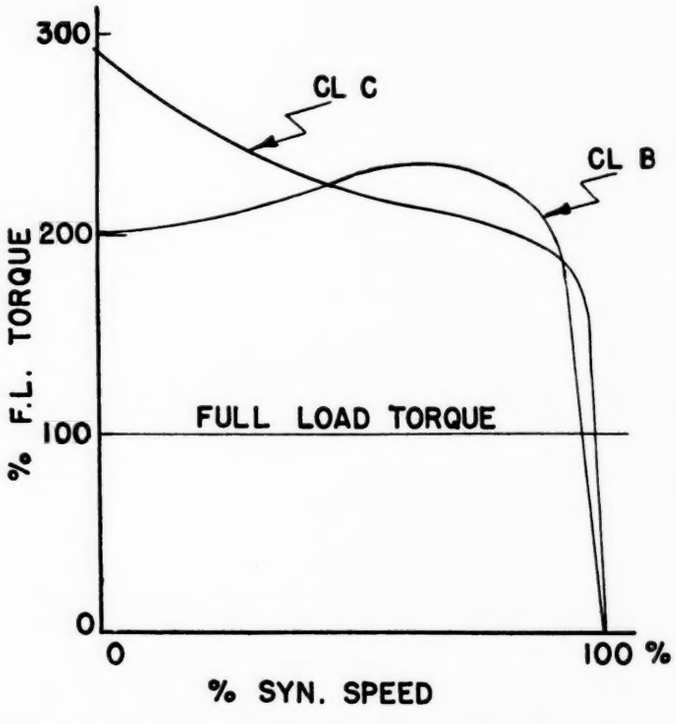


Fig. 3. Typical speed torque curves—Class B and C polyphase induction motors.

starting torque with relatively low starting current. However, the torque of the motor decays rapidly as it comes up to speed, and even the best designs tend to be deficient in torque at the switching speed. To overcome this, it is common to build the motors with an excess of starting torque, sometimes as high as 500%, so that the torque at switching speed is high enough, say 200%, to insure successful operation.

Running characteristics of this type motor are good, and compare with the capacitor motor. However, the efficiency is usually lower than for a polyphase motor of the same rating, as it is in all types of single-phase motors. The power factor is lower than for some types of single-phase motors, but power factor in itself is of little importance in the usual installation. The breakdown torque or maximum running torque is made large enough to do the job, but as explained, it may require that the motor have an excess of starting torque.

Reliability of the motor depends almost entirely upon two things—reliability of the centrifugal mechanism, and the brush life. Since this type motor has been manufactured for many years by those who now offer it, these devices in general have passed through the painful growing period and are as reliable as such

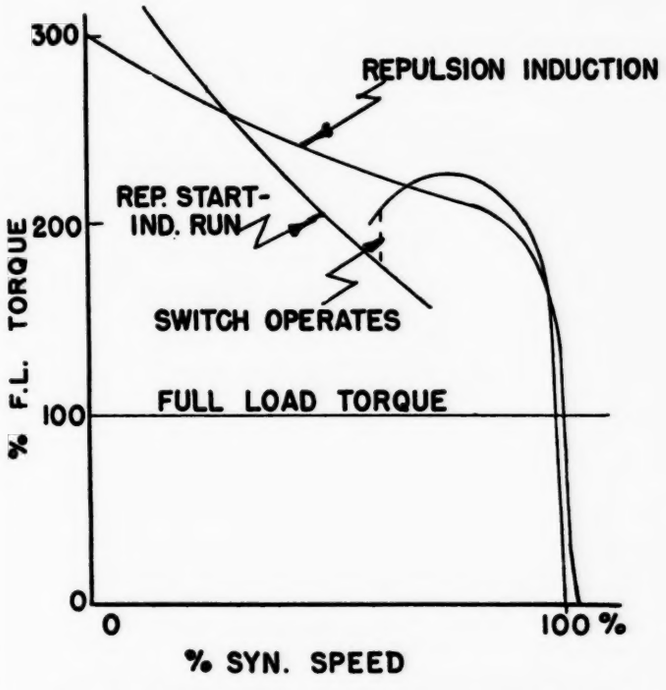


Fig. 4. Typical speed torque curves—single phase commutator motors.

devices can be. Life of the brushes depends not only upon the basic motor design, but also upon conditions under which the motor operates. In the integral-horsepower sizes, the majority of the motors built in the past have been of this type, and they have given a good account of themselves over the years.

Repulsion-Induction Motor

The term "repulsion-induction" is applied to a few types of motors in which the rotor carries a wire-wound repulsion winding, with its commutator, and a squirrel-cage winding. The motor gets its starting ability from the repulsion winding and its running torque from the combination of the two rotor windings. The change from the starting to the running condition is made electrically and magnetically so that there is no abrupt change in characteristics.

Commercial motors of this type have a relatively high starting torque, in the 250-325% range, and low starting current as shown in Fig. 4. Efficiency is competitive with all the other types and the power factor

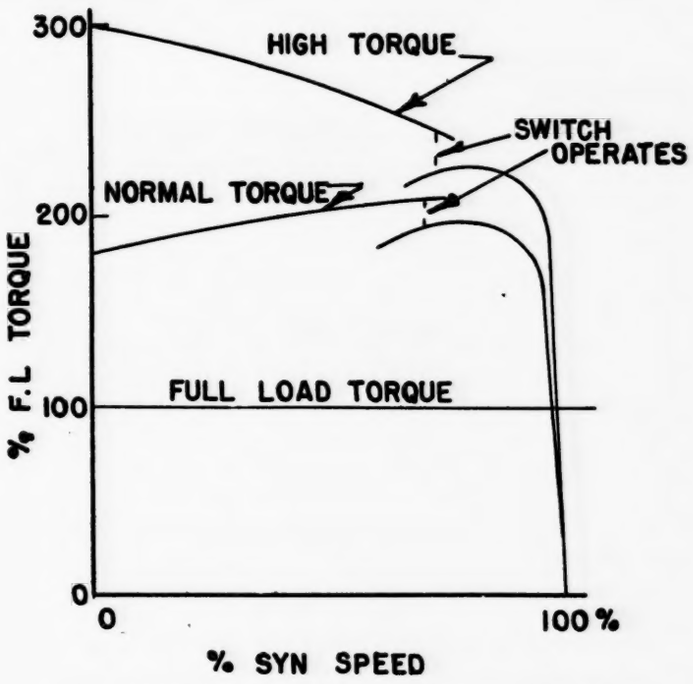


Fig. 5. Typical speed torque curves—single phase capacitor motors.

is extremely high. Because of the smooth transfer from the starting to the running condition, this type of motor excels in severe starting and accelerating duty, especially at low voltage.

Capacitor Motors

The capacitor-type motor has essentially a two-phase polyphase stator winding, although the two phases may have a different number of turns. The rotor has a squirrel-cage winding similar to a conventional polyphase motor. A capacitor, or a combination of capacitors, is used to produce a phase displacement in the current of the two stator windings. A true single-phase motor (one with only one-phase winding on the stator core) has no starting torque, and for this reason a capacitor must be used in the circuit at start to produce a phase displacement and starting torque.

If the starting torque is in the 150 to 350% range, the starting capacitance is far too great for the running condition. Therefore, all or some of the capacitor is cut out of the circuit when the motor reaches two-thirds or three-quarters of full load speed. The change over is made by a switch actuated by governor weights, current, or voltage. All accomplish the same purpose and although there are marked differences in the final characteristics of the motor under adverse conditions of over and under voltage, their operation is essentially the same.

Some motors have a small, continuously-rated capacitor in the circuit during the running condition, while others have all the capacitors switched out of the circuit. The former is called a capacitor-run or a two-value-capacitor motor while the latter is termed an induction-run or a capacitor-start motor. Although the addition of a running capacitor tends to increase efficiency, power factor, and breakdown torque, and decrease objectionable noise, the same results can be obtained or at least approached by other means at the designer's disposal. Thus the fact that the motor has

or has not a running capacitor should not bear too much weight in the purchaser's mind. The listed characteristics of efficiency, power factor, breakdown torque, starting torque, and starting current, together with the price, allow an economic selection to be made.

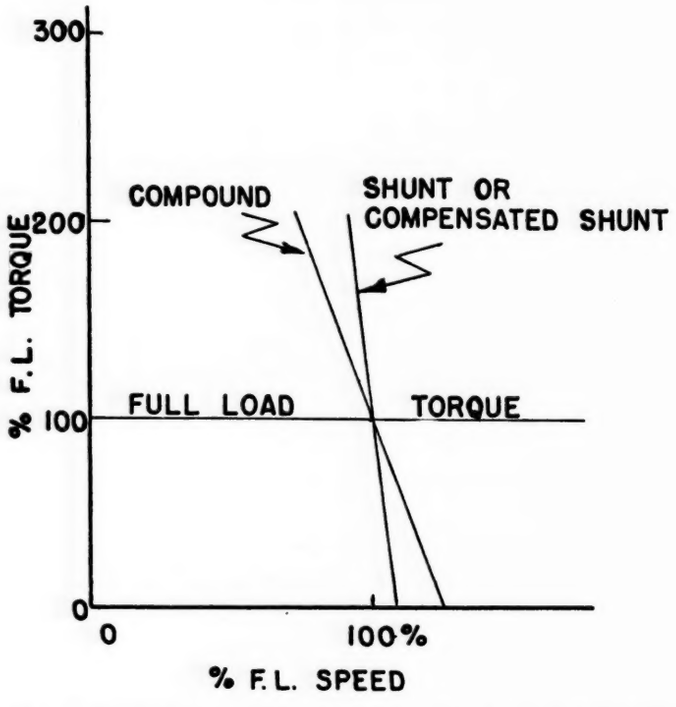


Fig. 6. Typical speed torque curves—direct current motors

Another variation, called a permanent-split-capacitor motor, has a relatively large continuously rated capacitor permanently connected in the circuit. Such a motor has low starting torque in the 30 to 60% range and relatively high breakdown torque.

Capacitor motors can be made with almost any combination of characteristics. High torque motors have about 300% starting torque and 200% breakdown torque, as shown in Fig. 5. Normal torque motors have something like 175% starting and breakdown torque, and low torque motors have about 50% starting torque and 175 to 250% maximum running torque.

Starting currents can be segregated into low and normal classes to agree in essence with the classifications of polyphase motors. Low-current motors have been allowed on the lines of practically all power companies, while normal-current motors have at times been prohibited. The low-starting-current motor is essentially a more expensive motor to build, and this must show up either in a greater price or in the reduction of some of the other characteristics of features. The choice of which kind of motor to use is one that desires a great deal of study by the purchaser, particularly if any great quantity of motors is to be purchased for one application.

Resistance Split-Phase Motors

Resistance split-phase motors are similar to capacitor motors in construction except that the capacitor is replaced with a resistor. Starting efficiency, running efficiency, power factor, and breakdown torque are all lower than for the capacitor motor, as is the cost. They are built only in the smaller fractional sizes below 1/3 hp, and therefore are outside the range of this article.

It is assumed that the reader is familiar with the basic types and construction of a direct-current motors. Constant speed motors are basically shunt motor while variable speed motors are series motors. A combination of shunt and series motors are called compound motors and are used to obtain desirable characteristics.

D-C Shunt Motors

The shunt connected motor is the basic constant speed motor, although in the larger sizes the starting and running characteristics can be improved by the use of a small series winding. These are called stabilized-shunt motors.

The shunt and stabilized-shunt motors are exemplified by relative constant running speed, Fig. 6, large short time overload capacity, and the necessity of using a starting resistor or automatic starter. The starting torque is limited by the mount of current passed by the starting resistor, which in turn must be limited to the capacity of the commutator and brushes. Practically, this is in the order of 200 to 400% of full-load torque.

D-C Compound Motors

Compound motors are shunt motors with a relatively large series winding on the main field poles. These motors have a sloping speed-torque curve which is of use in certain fan applications. In addition, the series winding limits the starting current, and thus the overloading of the commutator, so that they can be used in larger sizes without the complication of a current-reducing starter.

Series Motors

Series motors are little used in the heating and ventilating field and will not be discussed in detail. Their major use is in the traction field.

Having considered the different types and kinds of motors that are available, let us look at the various applications in the field of heating, ventilating, and air conditioning. These fall into the broad classes of fans, pumps, compressors, and stoker conveyors. One motor may drive more than one device on the smaller installations, such as the fan and oil pump of the ordinary gun-type conversion oil burner. The special requirements of each of the general types of application will be considered in connection with characteristics of the motors and the type best suited will be pointed out.

Fans

Fans are perhaps the most common application in this field, although the horsepower installed may be small in comparison with that of the compressor of an air conditioning system, or of the conveyor of a coal stoker. The power required to drive the several types of fans—propeller, axial flow, axial-flow vane type, sirocco—varies with the cube of the speed, for the same duct or back-pressure system, and with the same air density.

All this adds up to the fact that the motor must in practice have a fairly constant speed if output of the fan is to be maintained, or a drooping speed-torque curve if there is a change of overloading the motor because of varying back-pressure conditions. Thus the great majority of fans are powered with constant-speed motors. When a change in air flow is required it can be obtained by throttling, which reduces the fan efficiency, or by using a multispeed a-c motor, a wound-rotor a-c motor, or an adjustable speed d-c motor. In the case of fans moving air in refrigerated spaces, a motor with a drooping speed-torque curve may be desirable to prevent overloading at the low temperature.

The starting torque required by a fan is merely that necessary to overcome the break-away friction, and a motor starting torque of 25 or 50% is sufficient if the fan is direct connected. If the fan is belt-driven, the friction of the belt must be overcome, and 50 to 150% may be needed depending on the pulley diameter ratio.

For polyphase systems a Class B motor is usually used, although it has an excess of starting torque. For more than one speed, multi-speed motors are used. These are essentially two or more stator windings in the same motor. Of course only the standard a-c motor speeds are available which are 3,600, 1,800, 1,200, 900, 720, 600 rpm, etc., for 60 cycles.

For single-phase power, capacitor motors are widely used as the characteristics of this type are admirably suited for fan service. Low or normal-torque motors are popular since the requirements are not severe. Sometimes a special type of winding is used which allows multispeed operation with a reduced-voltage controller. However, on the low-speed connection, the speed is not particularly stable and the air delivery may be variable. Therefore this type is used primarily only on the fractional sizes.

Motors for belt drive almost always have sleeve bearings. Direct-connected propeller fan motors in the fractional sizes usually use sleeve bearings with a special thrust bearing, while the larger sizes are made with ball bearings since the fan thrust reaches an appreciable value. In addition, ball-bearing construction avoids "bumping" of the rotor back and forth in an axial direction, which can be very annoying.

Open or drip-proof motors are commonly used for belt-driven machines, while totally enclosed motors should be used when the motor is in the air stream since the air can deposit a great amount of dirt in an open motor, and this can cause insulation trouble. If the fan is handling flammable fumes a suitable explosion-proof motor must be used. Similarly, if combustible dusts are involved, a "dust-explosion proof" motor may be required.

In the smaller sizes, resistance split-phase a-c motors are employed because of their low cost and simplicity. The operation is much the same as that of the capacitor motor.

Direct-current motors are usually of the shunt or stabilized-shunt type except where the air may have a greatly varying temperature, in which case a compound motor is used to prevent overloading at the low temperature. The question of mechanical enclosures is the same as for a-c motors, except that greater care must be taken to combat dirt around the brushes and commutator.

Pumps

Pumps used in this field are either of the centrifugal or rotary, positive-displacement type. The former have the same characteristics as centrifugal fans and all the remarks apply equally well, as the same types of motors are used.

The power requirement of positive-displacement pumps vary with the first power of speed, and the break-away torque may be relatively high. Since they are liable to be small in rating, single-phase is often required, and a normal torque motor is usually used.

Compressors

The conventional compressor used for refrigeration or air conditioning work is a machine belted to run at some 400 to 600 rpm. The smaller compressors are often made without unloaders, and starting imposes a severe load on the motor. Therefore, a Class *C* polyphase, a high-torque single-phase capacitor motor, a repulsion-start induction-run, or a repulsion-induction motor is used.

This type of load commonly requires a motor with 250 to 350% starting torque and something over 200% breakdown torque. Since there is always a period of pull down at the start of each cycle, the motor must be applied so that it will carry the load even under adverse voltage conditions. In addition, the compressor

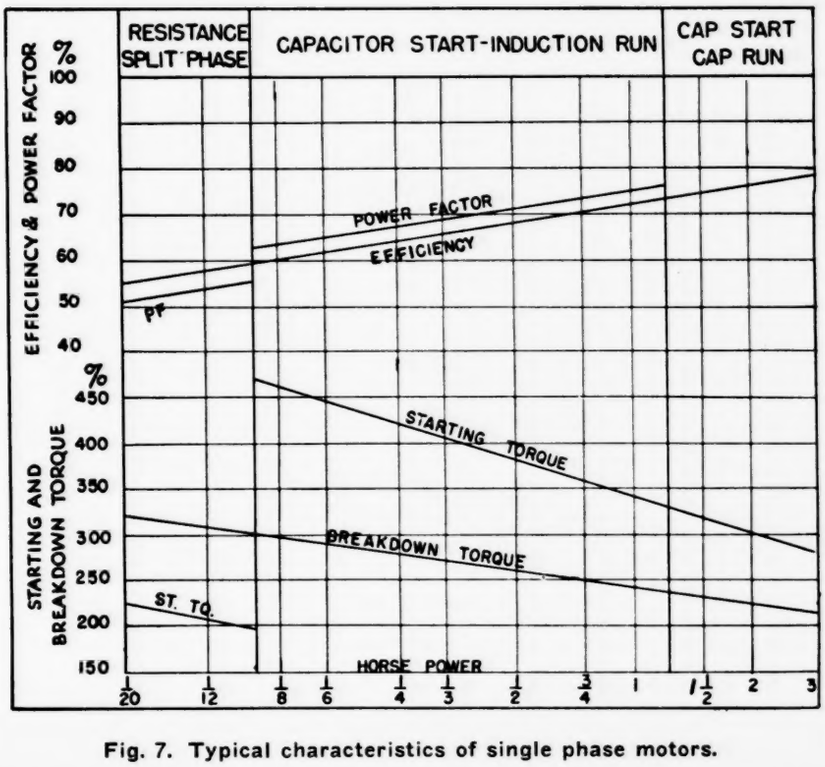


Fig. 7. Typical characteristics of single phase motors.

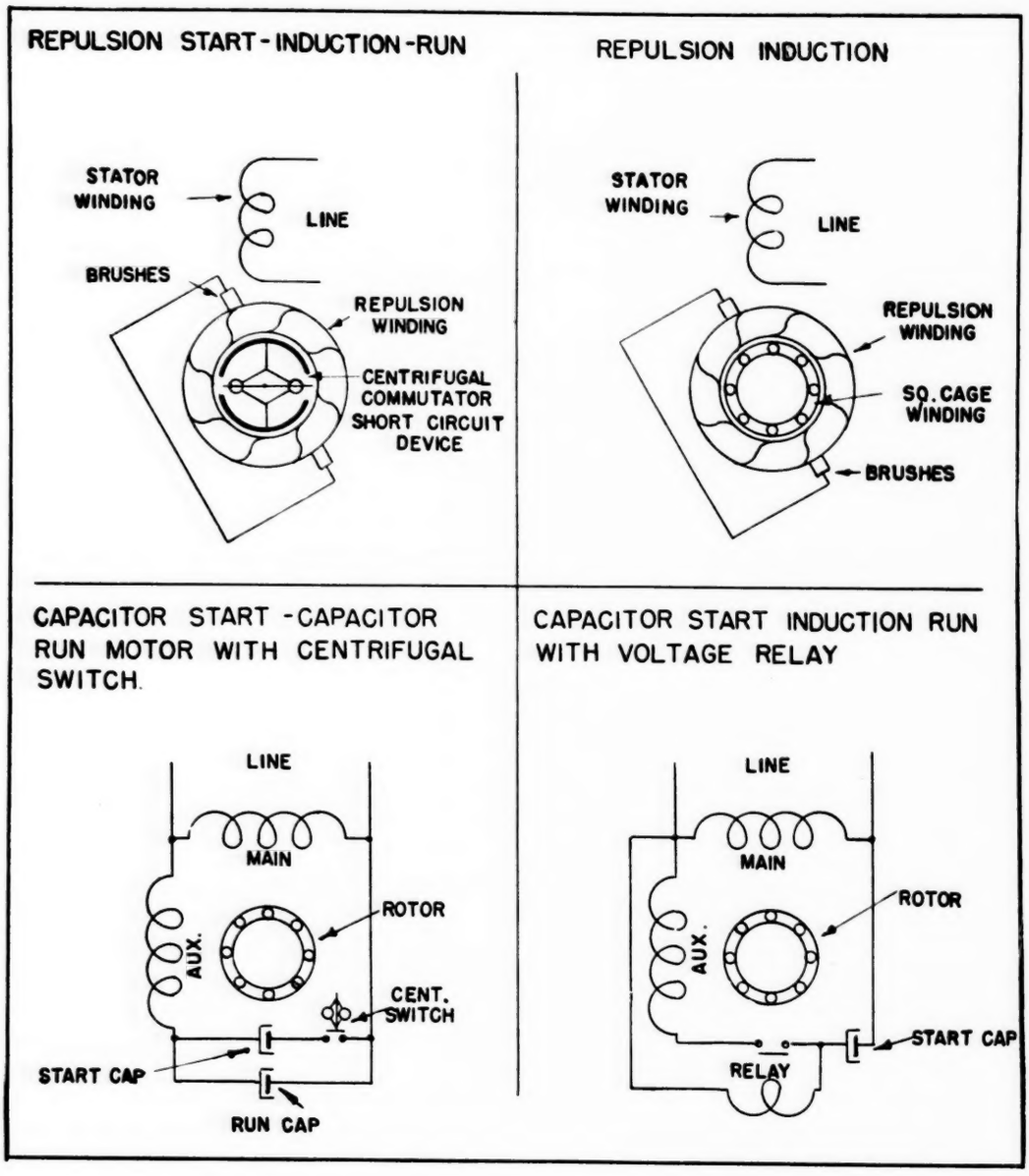


Fig. 8. Typical connection diagrams for single phase motors.

must not be used so that this load lasts long enough to overheat the motor or trip the overload relay.

When an unloader is used, the starting requirement is very greatly eased and any one of the normal-torque motors can be used.

D-C motors are usually of the shunt or stabilized-shunt type.

At start, only one cylinder undergoes compression at any time. The required starting torque, expressed as a percentage of full load torque, is decreased by a greater number of cylinders. Moreover, each cylinder adds a peak of torque to the load during running which is smoothed out to some extent by the flywheel. The residual peak of torque, as reflected back to the motor, should not exceed two-thirds to three-fourths of the breakdown torque in order that the efficiency of the motor while undergoing the peaks does not drop too markedly. If this limitation is observed, the rms (root mean square or average value) load can be used in all application calculations with perfect safety.

Hermetic Compressors

Hermetic compressors use motors which run in the refrigerant where no sparking contacts can be used, which rules out all commutators and motor-mounted switches, and either polyphase squirrel-cage, single-phase capacitor, or resistance split phase-motors are used. The switching device, mounted outside the motor case, is actuated by either a current or voltage coil. Where only d-c power is available, it is converted to a-c and an a-c unit is used.

The main problem in the hermetic motor design is to use an insulation that is neither affected by, nor affects the refrigerant and oil. In addition, the motor parts must be clean and dry to prevent the introduction of moisture and dirt into the refrigeration system since this would make the valves inoperative. The smaller motors are made without impregnation of the windings, while in the larger motors, the conductors, which individually must withstand considerable force, are held in place with some kind of bonding material. Synthetic varnish-like and synthetic rubber-like materials have been used with success.

Stokers

The coal conveyor of a stoker is usually of the screw type in which the load is mostly friction. Normal starting is not a hard job. However, a large lump of coal may wedge in the screw and if it must start under these conditions the torque required may be quite high. Therefore one of the high-torque motors should be used. Coal dust is very harmful to insulation, and all motors in the stoker room should either have special insulation, or, preferably, be totally enclosed or fan cooled.

Each of the various motor types that have become established as a standard in the electrical industry has been proved by experience to be suitable for its particular job. The problem is to select the proper motor and to use it to its best ability.

Data for Proper Design of Poultry Houses Result from Government Research

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The author presents the latest data on heat and moisture emission from chickens, the results of continuing Department of Agriculture research. The latter half of the article is devoted to practical suggestions for proper design of poultry houses.

THE design of structures for the proper housing of animals (including man) requires exact information relative to three distinct fields of physical research:

(1) Seasonal variation in temperature and humidity;

(2) Characteristics of structural materials, both mechanical and physical; and

(3) Effect of the animals housed upon the environment.

Sufficient information relative to the first field can be obtained by analyses of Weather Bureau records, while handbooks contain all necessary information on structural strength of materials, upon stresses in building members, insulation values relative to heat interchange, and other factors.

However, there has been a dearth of information in the third field, although knowledge in this field is necessary and highly important for proper design of structures which will house the animal comfortably and enable it to maintain optimum growth and well being. When animals are housed in any structure, environmental conditions are greatly different than if the structure were unoccupied, due to the fact that an animal emits considerable quantities of heat and water vapor. The amount of this heat and water vapor must be taken into account in the design of housing structures and the calculation of the correct power load for heating and ventilation. Only thus can the proper environment be economically assured. The animal also consumes oxygen from the air and eliminates carbon dioxide into the atmosphere. (Other gases: methane, sulphur dioxide, etc., are eliminated from the intestinal tract). Recognition of the importance of accurate data on these factors is becoming more and more wide-spread.

To obtain information relative to the heat and gaseous exchange requires careful and accurate research with an instrument of precision known as the respiration calorimeter, first designed and constructed in this country in 1892 by W. O. Atwater and E. B. Rosa.

Briefly, this instrument consist of an air-tight, thermally-insulated chamber in which the animal under study is placed during the period of observation. For the measurement of heat the apparatus is a constant-temperature, water-flow calorimeter, in which the calorimetric features provide for the prevention of the passage of heat to or from the calorimeter and its environment; and for the removal of heat generated within the calorimeter in such a way that it may be measured.

As a respiration apparatus, the gas-tight chamber is connected to a system of gas absorption flasks in a closed circuit. The gas (air) confined within the system is kept in circulation through the chamber and gas absorption flasks. The gaseous products imparted to the air by the living material are constantly removed and oxygen is supplied to take the place of that used by the animals.

Over a long period of years from its inception to 1923, this apparatus was in use by the Department of Agriculture in Washington for the study of the metabolism of man. The results obtained in these investigations may be found in United States Department of Agriculture bulletins.

Since 1924 the energy and gaseous exchange of the domestic fowl have been investigated by the writer and his associates at the Agricultural Research Center, Beltsville, Md., using a respiration calorimeter designed upon the principles previously stated, but with many improvements in detail and constructed to fit the nature of the experiment.

Fig. 1 shows a view of the laboratory and some of the fittings as set up for this use. The view shows

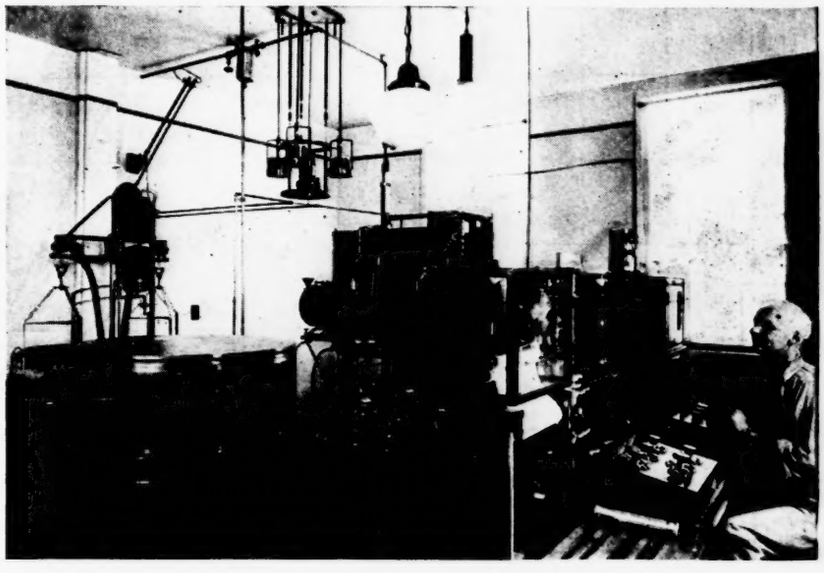

Fig. 1. Calorimetric Laboratory, Agricultural Research Center, Beltsville, Md.

two calorimeters, one circular and one nearly square but somewhat longer than its width. The control board in the foreground is where all measurements of temperature were made. Temperature is determined by use of platinum resistance thermometers and by copper-constantan thermopiles. The operator is shown observing the deflections of a galvanometer, used with a potentiometer, to determine thermocouple temperatures. On the table at his left is a Wheatstone bridge for determining temperatures by measuring the resistance of the various resistance thermometers. In the foreground is an automatic temperature recorder which gives a continuous record on a chart. Other apparatus can be seen which control the temperature of various regions within the calorimetric set-up by varying the resistances in the electric heating circuits. The absorption train for removing the carbon dioxide and water vapor can be seen directly in the rear of the control panel.

This apparatus, as stated before, is used for measuring the heat, carbon dioxide and water elimination and oxygen consumption. According to the law of conservation of energy the total input must equal the total output. Energy is required for the assimilation of feeding stuffs, for the vital processes of life, for work, and to maintain body temperature. Since the energy expended to maintain body temperature is dependent upon the temperature of environment, this factor can have a profound effect on the feed consumption of the fowl and also on meat and egg production.

During an investigation of the metabolism of the fowl from 1938-1941, inclusive, using the apparatus mentioned above, a total of more than 500 experiments were made to determine the effect of the temperature of environment on the heat elimination of Rhode Island Red chickens. The results obtained are summarized in the nest of curves shown in Fig. 2.

These curves show the heat elimination of chickens of several different ages covering the life cycle from hatch to maturity, at a relative humidity of 60% and a temperature range from 0 to 100F. or over such portion of this range in which the chick could survive under the conditions of the experiment. Below a certain temperature (shown by the break in the curve at the lower temperature) the chick will perish from cold if exposed a sufficiently long period. This minimum temperature for survival is somewhat below 70F for chickens under two weeks of age but becomes lower and lower as the age of the chicken increases, until for chickens over 12 weeks of age the temperature is below 0F.

Structure Design

In the design of a structure, the heating load must be determined. The curves shown in Fig. 2 may be used to determine what part of this load will be supplied by the chicken. In using these values it must be borne in mind that they are minimal, because the chicken was at rest and it had been without feed for 12 to 15 hours before the experiment started. Under ordinary conditions of feed and activity the excess heat generated must be taken into account and therefore the values shown in Fig. 2 would be larger. Just how much greater the values should be cannot at present be stated with accuracy. A line of investigation to determine the heat output of fowls under normal living conditions is now being planned.

The water vapor the chickens eliminate from the respiratory tract depends mainly upon the temperature of the environment. The activity of the fowl and the humidity of the environment also have an appreciable effect upon this factor.

Fig. 3 shows the amount of water eliminated from the respiratory tract of the chickens at rest, 60% relative humidity and temperatures between 40 and 100F. The range of temperature for young chickens is shorter because the chickens could not survive the lower temperatures. Below 40F the curve has been extrapolated as data could not be obtained below this temperature due to precipitation of moisture on the cooling coils. One will notice immediately upon inspection of the curves in Fig. 3, the extremely rapid increase in water elimination at temperatures above 80F.

The body temperature of a man is controlled to a large extent by evaporation of perspiration at the skin surface. The heat necessary for

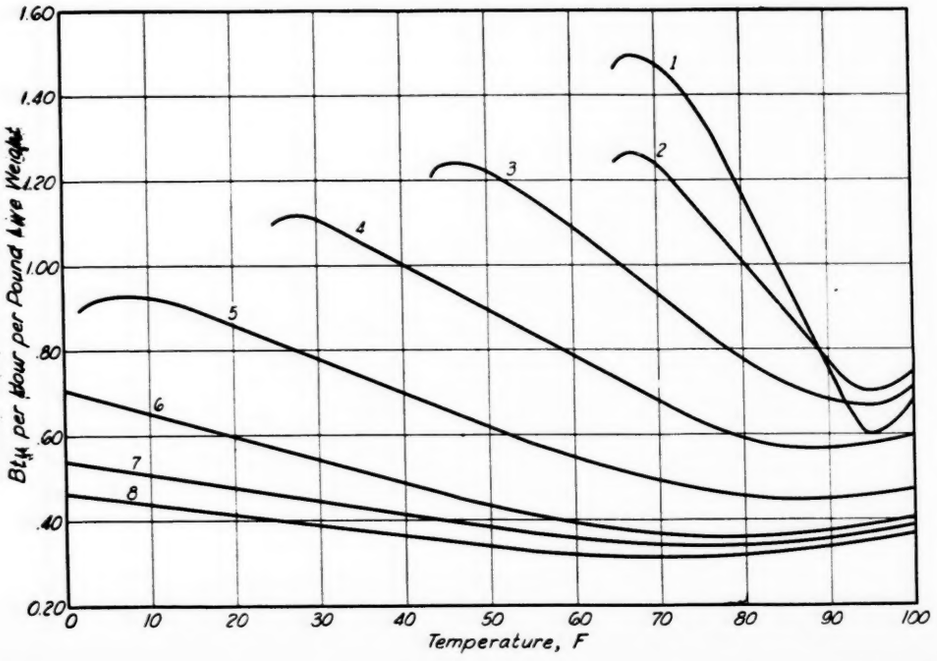

Fig. 2. Heat emission of chickens from hatch to maturity at various temperatures of environment.

Curve	Age	Weight, Lb
1	Baby chicks	0.08
2	2 weeks	0.20
3	5 weeks	0.57
4	8 weeks	1.30
5	12 weeks	2.27
6	18 weeks	3.54
7	23 weeks	4.31
8	1 year	5.35

this evaporation is taken from the skin surface, thus cooling the body. A chicken however, has no sweat glands, but has a natural cooling system within its body. This cooling system consists of nine air sacs, or bladders, which are interspersed throughout the body cavity and in intimate contact with the body tissues and viscera. The air (when in use as a cooling medium) passes directly through the lungs and into the various air sacs. Here the air becomes nearly saturated with water which is evaporated from the living tissues. The heat necessary for evaporation is taken from the tissues, thus cooling them. There is a fine balance here and only enough moisture is evaporated to keep the body temperature from rising. The more necessary it becomes to remove heat, because of increase in temperature of the environment, the more rapid the breathing and the greater is the increase in the volume of air inhaled and exhaled. In extreme heat the chicken will be panting violently with its bill wide open. Now it can be seen why the humidity of the environment has an effect on the temperature control system, because if the air has a high moisture content, less moisture is necessary to bring it to the saturation point and therefore there is less cooling per volume of air inhaled, and the chicken's efficient cooling system is working at a decided disadvantage. Therefore a chicken will survive a high temperature at a low humidity, while the same temperature might be fatal at a high humidity, because of the nature of the system.

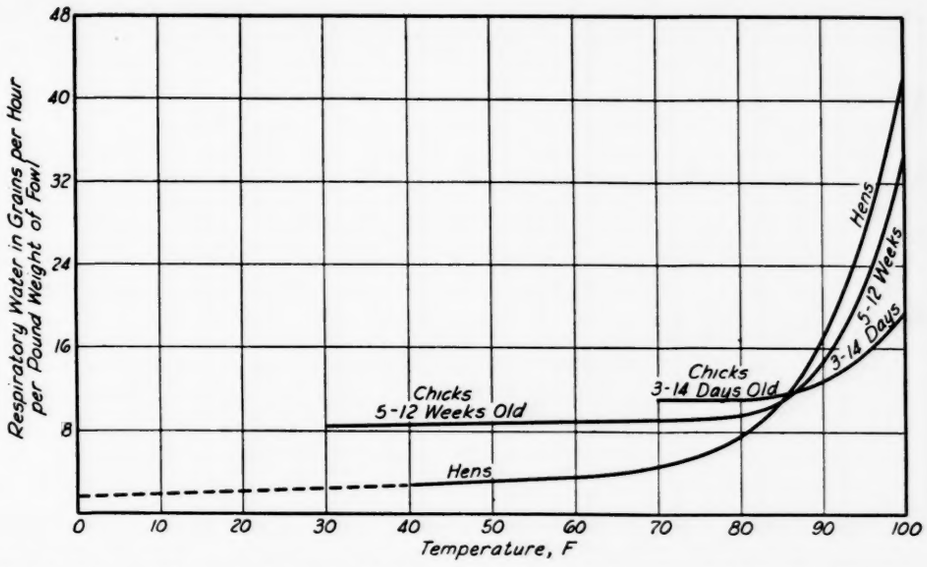

Fig. 3. Water of respiration of chickens at various environmental temperatures.

Therefore, in the design of structures for poultry, the humidity should be kept below 70% and the temperature for mature fowls at about 60F. For younger birds the temperatures should be higher, depending upon the age of the chicken. As can be seen by a study of Fig. 2, the lowest point on each curve indicates the temperature where the metabolic activity was a minimum but the optimum temperature for the chicken seems to be somewhat lower than the temperature indicated by this point. This is due to the fact that the chickens used in these experiments had no feed or water during the experimental period and for some hours before and that their movement was almost completely restricted. The supply of oxygen necessary for respiration, and removal of the carbon dioxide and other gases eliminated will be automatically controlled if the ventilation is sufficient to keep the odor level from becoming too pronounced.

One other feature of poultry-house operation should be mentioned. If the house is comparatively tight, as it must be for proper air conditioning, there will be a greater amount of dust in the air from the litter and other sources than can be handled by an ordinary filter. A dust collector of the bag type should be installed between the air outlet and regular filters. This will remove the greater portion of dust and it can be cleaned and renewed for further use by a simple shaking device which clears the bags of dust already collected.

Pebble Heater

An operating model of a pebble heater, a heat transfer unit developed by The Babcock & Wilcox Company, was featured at the B & W Refractories Division exhibit of the National Metal Congress and Exposition at Atlantic City the week of November 18. This unit has been successfully used to heat air to 2300F and steam to 1800F.

The pebble heater is capable of heating gases above the operating temperatures permissible in metallic heat interchangers. The principle involved consists of heating to high temperatures a moving column of pebbles made of a heat resistant non-metallic material, and then passing the gas to be heated through the moving column of hot pebbles.

The pepple heater has been used for heating the air utilized in the combustion of fuels. By using highly pre-heated air, temperatures can be reached which have been generally considered to belong in the field of electric furnaces, and far exceed the temperatures required for melting steel.

In the field of refractories, a continuous melting operation has been developed in which furnace construction materials, in themselves very resistant to high temperatures, can be melted and poured like molten steel, to give them an even greater temperature use limit.

In the general field of process chemistry, the pebble heater, because of its large heat transfer surface, is particularly suited for rapid heating of gases to high temperatures.

Riser Arrangement for Downfeed Vacuum Systems

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THE proper design of a down-feed vacuum steam heating system was recently under discussion in an engineering office. Two proposed layouts, shown in Fig. 1 and 2 were compared from the standpoint of collecting the drips at the ends of the risers. Traps could not be installed at the riser's ends because the risers end in the middle of a ceiling. Some felt that the arrangement shown in Fig. 2 would short circuit and steam never reach the far units; others claimed that this would not be true of a vacuum system.

Our own opinion is that any arrangement such as shown in Fig. 2 may not be satisfactory at all times, may produce some troubles, short circuits, some air binding, sluggish heating and water hammer. Sometimes such systems do work, however, provided the return main is made oversize so as the store condensate tmporarily until relieved by the trap.

On the one hand the return main should be small so as to contain but little air to be driven out when first heating up, the air in the supply mains being largely liberated through the radiator traps; however, it is more important to have a drip main large enough to store abnormal condensation temporarily.

In explanation, of the inherent difficulties in a short circuit system, refer to Fig. 3 and assume one pound drop in pressure between *A* and *B*, also from *B* to *C*, and *A* to *D*. Steam then finds it easier to flow backward in the drip line *D* to *C* than it does anywhere else, because there is a differential of 1 lb, between points *D* and *C*. There is also a differential of 1 lb, between *A* and *B*, but this is due to the resistance to flow. There is no appreciable resistance between *D* and *C* as this line is only for passing condensate.

Steam takes the shortest route from *A* to *D*, the line of least resistance, reaches and closes the trap before all air and water are relieved, providing the trap is of the thermostatic type. Presumably, however, the trap is of the bucket type, as it should be.

Results when the system is in normal operation will vary somewhat from those when it is first heated up, since cold piping produces abnormal condensation while cold radiators call for a lot of steam which, of course, increases the pressure drop.

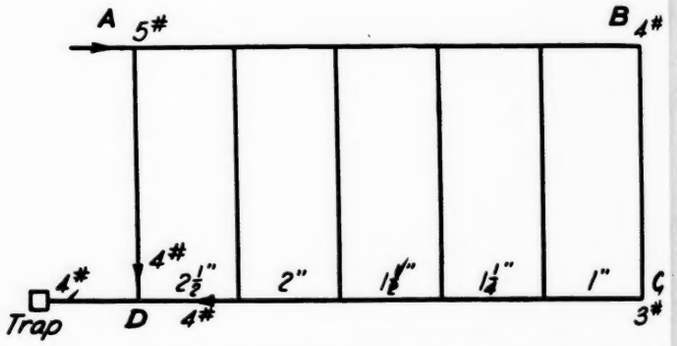

Fig. 3. Difficulties in a short circuit system. See text.

If the steam is supplied from a low pressure heating boiler, the supply will not be equal to the demand for the first 20 or 30 minutes, so that natural condensation in the far end of the system producing partial vacuum at such places for a time may cause the backward flow and condensate to be held up.

If the steam is supplied through a pressure reducing valve from a high pressure boiler or by street steam, the supply will be equal to the demand. There will be no points of vacuum, but the pressure drop will be great, as will the amount of condensate in a given time.

The vacuum system only carries the vacuum up to the radiator traps and the one drip trap. A vacuum system helps in liberating the air when first heating up and at other times helps by increasing the differential between supply and return mains so as to produce a greater flow and pressure against the resistance.

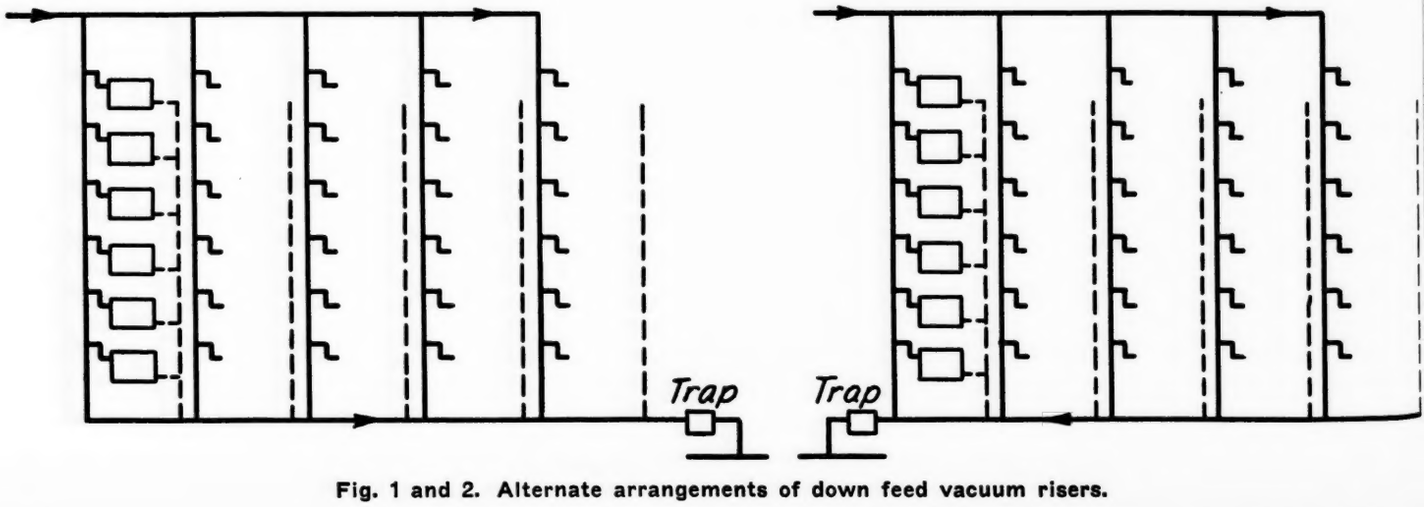

Fig. 1 and 2. Alternate arrangements of down feed vacuum risers.

Law for the Heating Contractor

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Interesting points of law are brought out in this summary of higher court decisions involving heating contractors and companies.

ALL heating contractors have good lawyers at their disposal, but what can a good lawyer do to win a suit if the contractor has already lost it?

Statistics positively prove that the only dependable plan by which anyone is certain of winning a law suit is: Let the contractor conduct his business and prepare to win suits. This may be accomplished only by readers who keep informed of the cause and outcome of new and modern higher court decisions involving other contractors. Some of the important decisions are reported in this article.

Parts Interchangeable

Considerable discussion has arisen from time to time over the legal question: Can a seller who contracts to install a "specific" heating unit install a different but equally efficient unit, without being liable to the purchaser for breach of the contract?

For illustration, in Mathis v. Holland Furnace Co., 166 Pac. (2d) 518, reported April, 1946, the testimony proved that a home owner, named Mathis, entered into a written conditional sales contract with the Holland Furnace Co. for the installation in the former's home of a heating system, including a furnace, a stoker and controls, one new warm air and one new cold air run. The cash price stated in the contract was $555. The contract stipulated that No. 250 furnace would be installed. After the job was completed Mathis signed a "completion" certificate certifying "that all articles and materials have been furnished and installed and the work satisfactorily completed. . . ."

Several months later Mathis sued the Holland Furnace Co. for heavy damages on the plea that although he contracted and paid for a No. 250 furnace the company installed a No. 2500 furnace against his will and consent. The officials of the company admitted during the trial that a No. 2500 furnace was installed but alleged that the two furnaces, No. 250 and No. 2500, were structurally the same. Parts were interchangeable, except for minor castings, and the price list was the same on both. The higher court refused to hold the furnace company liable, and said:

"The record definitely bears out the fact that the only difference between the two furnaces, No. 250 and the No. 2500 which was installed, is the number on the door and the change in the method of installing the baffle-iron in back of the fire-box; that in all other respects the two models were the same, the same fire-box capacity, the same heating capacity and efficiency, the same material and weight, with the parts interchangeable, and the same value."

Also, see Holt v. Sims, 102 N. W. 386. In this case a heating contractor agreed to install a heating system and install a "No. 3" boiler. This contractor was unable to obtain a No. 3 boiler and a No. 5 boiler was furnished, which was of better quality and greater heating capacity than the one specified in the contract.

In a subsequent suit the higher court held that the property owner must pay the full contract price, saying:

"It seems almost finical for the defendants (property owner) to complain that their house was not well heated because the plaintiffs (contractor) did not provide a suitable furnace upon the ground that the one furnished was really better in this respect than that which was named in the contract."

Delinquent Payments

It is well established law that, under ordinary circumstances, a seller of heating equipment may repossess the equipment the instant the purchaser fails to fully comply with the contract to make monthly payments. However, this rule of law is not applicable, if the seller has customarily accepted overdue or delinquent payments from the purchaser.

For instance, in Commercial Securities Co. v. Mattingly, 26 So. (2d) 37, reported August, 1946, it was shown that the General Gas Corp. sold to a property owner certain gas heating equipment for $235.50. The latter gave his note and a chattel mortgage as payment. The property owner agreed to make monthly payments on the first of each month.

In subsequent litigation, over the amount due, the seller contended that it had a legal right to repossess the equipment because the property owner failed throughout the contract to make the monthly payments on the first of each month. The higher court refused to permit the seller to repossess the equipment, saying:

"Defendant (property owner) had not been in the habit of paying the installments promptly. The evidence shows that for the past twelve months he was allowed to pay the installments on the 25th of each month. He then had reason to believe that the July installment was not past due on July 10."

Defective Furnaces

Generally speaking, where a seller breaches a contract, the purchaser can return the merchandise, and compel the seller to pay damages amounting to the profits lost by being unable to resell the merchandise. However, this rule of law is not applicable where a heating contractor breaches a contract to install heating equipment. The property owner may reduce the contract price depending on his cost to put the heating equipment in condition to comply with the terms of the contract.

For example, in Mangin Heater Service, 24 So. (2d) 384, reported May, 1946, a heating contractor sued a property owner to recover the balance due on the contract price for a defective heating unit installed in a home. The property owner demanded that the contractor return all money previously paid. Thus the property owner would have had the "defective" furnace free and without cost.

The higher court held that the property owner must pay the full contract price less $15 the estimated cost to put the furnace in condition to comply with the terms of the contract. This court said:

"The remedy of the owner in such cases is for a reduction in the price to an amount necessary to perfect or complete the work according to the terms of the contract."

Liability for Fire

Contractors and sellers who install heating units assume full responsibility for negligent installation that causes damage to the property owner.

For illustration, in Russel v. Union, 191 S. W. (2d) 278, reported February, 1946, it was shown that a building and its contents burned as a result of negligence of a contractor who used sharp edged staples to fasten electric wires to the building while installing electrical connections to a heating unit. The staples cut the insulation on the wires causing a "short" which set the wooden building on fire. The higher court held the seller fully liable in damages.

Patent Invalid

According to laws of the United States no inventor may obtain a valid patent on any device used, sold, or shown in a newspaper or magazine 12 months before the inventor invented the device for which he filed an application for a patent. This is United States law, although inventors in many foreign countries may obtain in their countries valid patents on inventions invented by United States inventors, thus preventing the latter from marketing and selling their own inventions in these foreign countries.

In Safety Car Heating & Lighting Company v. General Electric Company, 155 Fed. (2d) 937, reported July, 1946, the Safety Car Heating and Lighting Company sued the General Electric Company for infringement of its patents Nos. 1,708,625, and 1,708,626. These patents were for improvements in refrigerators. The patents were on a rotary fan driven by one motor, outside the compression chamber, and a compressor in that chamber, driven by another motor. The purpose was to make it sure that the compressor motor could not operate, if the fan motor stopped.

The higher court held both patents void, and said:

"While it is of course true that a 'polyphase' fan must have some merits, the evidence we have just summarized satisfies us that it is only one of that myriad of variants which every active art proliferates.

"It is therefore quite apparent that under the same conditions and circumstances these patents may now be in valid use and production in certain foreign countries, as for example England where anyone may obtain a valid patent if he only files the application, although he is not the inventor, and complies with laws in England."

Implied Warranty

Generally speaking, where parties have deliberately contracted in writing, the higher courts presume that their whole engagement and the manner and extent of their undertaking are embodied in the written contract. However, a seller always is liable on an "implied warranty" that a heating unit will give reasonably satisfactory service.

For example, in Greenland Development Corp. v. Allied Heating Products Co., 35 S. E. (2d) 801, reported February, 1946, the testimony showed that a development corporation commenced the construction of 75 small dwelling houses. When foundations for the first 10 houses were being laid out on the ground, a salesman for Allied Heating Products Co. interested the development corporation in a heating unit known as "Fluemaster."

This unit was designed to be installed and operated in this manner: A brick chimney was to be constructed through the interior of the house. Inside the chimney, at the first floor level, there was to be constructed a fire box, for burning coal, lined with fire brick and covered with a metal plate or lintel. In this lintel there was an opening to which was attached a porcelain flue of smaller diameter than that of the brick chimney. The hot air which accumulated in the space between the exterior of the flue and the interior of the chimney was forced, by a blower or fan, through metal ducts and distributed throughout the house. The development corporation and the Allied company entered into a written contract by the terms of which the former contracted to supply 75 heating units for $202.50 a unit. This contract contained a clause: "Seller guarantees all materials . . . for one year against defective material and workmanship. One year for service. Subject to FHA approval."

The FHA approved the units. The chimneys were constructed by the development corporation and the Allied company delivered and installed the furnaces in the respective houses.

Trouble soon developed in most, if not all, of the furnaces. The metal grates became warped and the fire brick disintegrated. In some the thermostats burned out. In others the furnace tops or lintels melted, with the result that fumes and gases accumulated in the heating space in the chimney and were blown through the ducts into the living quarters.

The development company sued the seller, the Allied company, for damages on the contention that the latter breached its "implied warranty" that the heating units would give reasonably satisfactory service.

During the trial the seller argued that it could not be held liable in damages on an implied warranty because the written contract contained the above mentioned express warranty that it guaranteed the materials against defects for only one year.

In this respect the higher court held that notwith-

standing the written contract contained these various clauses, the seller "impliedly" guaranteed that the units would be reasonably suitable for the purpose of heating the houses, and would perform the function for which they were purchased in a reasonably sufficient manner.

Also, the seller argued that it might "cure" the defects. In this respect the higher court held:

"The plaintiff's (development corporation's) right to recover was not dependent upon whether the defects, if any, in the furnaces were curable or incurable."

Also, this higher court held that although the written contract contained the provision that the installation of the heating unit was "subject to FHA approval," the seller still may be liable for defective materials, notwithstanding the FHA approved the installed heating unit. This court said that although a government agent or representative "approves" a heating plant, this fact will not prevent the contractor from being liable for breach of his contract.

Must Prove Injury

Modern higher courts consistently hold that an employe who sues to recover compensation under the State Workmen's Compensation Act must prove the case in all details, or he can recover no compensation.

For illustration, in Golinski v. Odin Stove Manufacturing Co., 48 Atl. (2d) 95, reported September, 1946, it was shown that an employe sued his employer to recover compensation under the State Workmen's Compensation Act alleging that he was totally disabled as a result of silicosis.

The employe failed to positively prove that he had contracted the disease while in the employment. Therefore, the higher court refused to allow the employe any compensation, saying:

"Claimant (employe) had the burden to prove all the essential elements of his case including the fact that his total disability was caused solely by silicosis, ..."

Physical Injury

According to a late higher court decision loss of one joint of a finger or thumb is insufficient for workmen's compensation authorities to allow compensation for permanently lost use of the finger or thumb.

For illustration, in Himes v. Stoker Sales and Service, 45 Atl. (2d) 234, reported April, 1946, while lifting a Stoker an employe's thumb was injured and one joint was amputated. The higher court refused to allow compensation based on "permanent" injury to the thumb.

Personal Property

Modern higher courts consistently hold that if equipment is not permanently affixed to realty it remains "personal" property and is removable as such. Also, a clause in a mortgage reserving title in an old heating system is not applicable to a newly installed unit.

For example, in Keil Motor Company v. Home Corp., 47 Atl. (2d) 164, it was shown that a home owner named Maxwell executed a mortgage thereon to the Home Corp. in the sum of $5,520. This mortgage expressly covered "all heating, plumbing and lighting fixtures and equipment now or hereafter attached to or used in connection with the real estate herein described."

The old heating apparatus in the house became entirely insufficient and unsatisfactory and Maxwell made a contract with a contractor who installed an oil burning unit, including boiler, circulating pump, flow control valve, automatic flow and release valves, fittings, and water expansion and storage tanks. This contract was evidenced by a conditional sales agreement by which the contractor reserved the title to the heating unit and accessories until after they had been fully paid for.

Defaulted

Later Maxwell defaulted in his payments under the conditional sales contract and also on the mortgage payments on the house.

The mortgage was foreclosed and the new purchaser contested the right of the contractor to remove the heating equipment from the house on the argument that the mortgage on the house "reserved" the title to the heating system.

However, since the conditional contract on the new heating equipment was recorded, although after the mortgage on the house was recorded, the higher court held that the clause in the mortgage releated exclusively to the old heating system and not to the new equipment installed by the contractor.

Therefore, the court authorized the contractor to remove the equipment which he had installed. This court said:

"If the old heating plant had in fact no value as a heating plant, and was not able to be operated, then its removal could have had no effect upon the security of the mortgage, and surely the prior mortgagee should not benefit and obtain entirely new heating equipment because the conditional vendor, by the installation, had reinstated the freehold as a habitable dwelling."

Chattels Not Retaxable

All modern higher courts are in accord with the proposition that a tax statute should be given a reasonable construction, and one which was presumed to have entered the mind of the legislature.

For illustration, in Surface Combustion Corp. v. Glander, 68 N. E. (2d) 586, reported October, 1946, it was shown that a partnership known as Surface Combustion was engaged in the business of manufacturing heating and air conditioning appliances.

The higher court held that the new corporation need not relist its property and chattels for taxation, although the state law provides that a corporation engaged in business between the first day of January and the first day of July shall list the probable average amount of personal property intended to be used in the business until the first day of January.

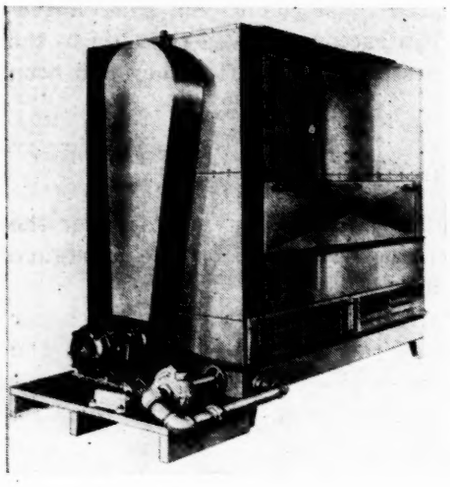
NEWS OF EQUIPMENT AND MATERIALS

Cooling Tower

NAME—Marlo cooling tower.

PURPOSE—To simplify water problems of air conditioning and refrigeration plants.

FEATURES—Unit is a modification of the company's evaporative condenser with the exception that in



place of the condenser coil, wetted deck surface is used. Tower is light in weight and sectionally built. Mechanical draft feature makes unit independent of prevailing wind direction or wind velocity.

LITERATURE AVAILABLE — Bulletin 406.

MADE BY — *Marlo Coil Co., 6135 Manchester Avenue, St. Louis 10, Mo.* **243**

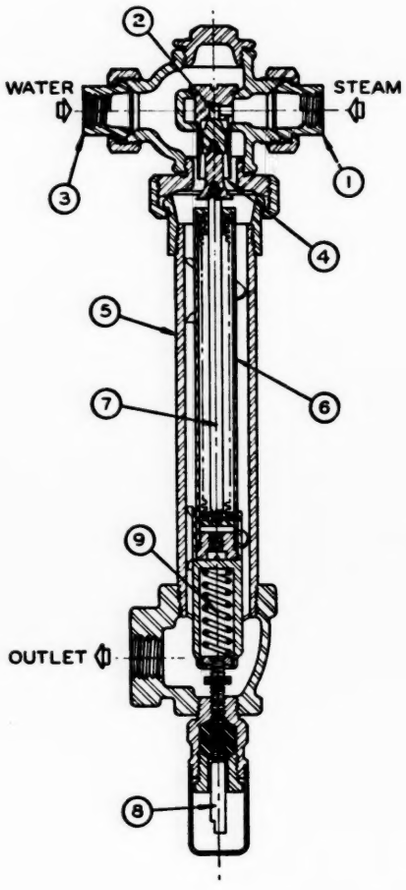
Water Mixer

NAME—Sarco steam and water mixer.

PURPOSE—For providing hot water in isolated points of factories. Designed to eliminate the need for pipinghot water lines or for long distances.

FEATURES—Built-in thermostat insures automatic operation and sensitive temperature control. Hot water capacities are 200 gal per hr with a temperature rise of 50 to 120F for a steam pressure of 75 lb per sq in.

OPERATION—Steam enters at 1 and goes through valve 2. Cold water enters at 3 and mixes with steam in injection chamber 4. Resulting mixture of hot water enters hous-



ing 5 and flows over thermostat 6 which is filled with Sarco liquid and is hermetically sealed. When hot water flows over it the liquid expands and gradually pushes plunger 7 forward to close valve 2 and thus cut off the steam at temperatures set by control 8. Body 5 is then cooled by radiation and liquid in thermostat 6 contracts and plunger head 7 opens valve 2. Relief spring 9 prevents damage from accidental over-heating. Steam pressure must be 20% higher than water pressure.

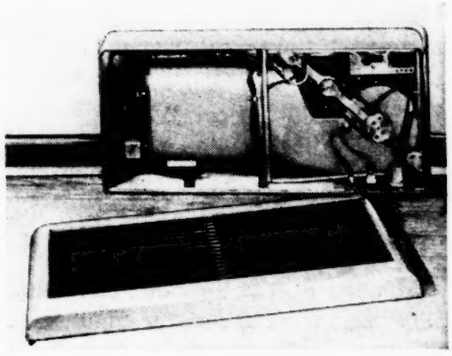
MADE BY — *Sarco Company, Inc., 475 Fifth Avenue, New York 17, N. Y.* **244**

Home Furnace

NAME—South Wind home heating furnace.

PURPOSE—Space heating in the home.

FEATURES—Unit, furnace, burning manufactured, natural or bottled gas, is about the size of a suitcase and provides automatic heating. A sealed flame system makes it possible to burn the fuel in a confined, sealed space so that instead of the conventional chimney, metal tubes can be used for ventin. Air for combustion is drawn from outside the house. With an input of 31,000 Btu, the output is 25,000 Btu. The unit is small enough to be recessed



in a wall between two rooms or placed beneath a floor in the space between joists. It is designed to heat 2½ rooms. Without the cabinet it weighs 45 lb; with the cabinet, 70 lb. For a 5-room house, one unit should be used for the downstairs rooms and another for upstairs. An advantage is the resulting zone temperature control. The heater is built of stainless steel and utilizes aircraft heating principles. Should repairs be required, it is said to be simple to replace the furnace and then reinstall the original unit after repairs are made.

MADE BY—*Stewart-Warner Corporation, Heater Division, Indianapolis, Ind.* **245**

Electrodes

NAME—Wilson automatic arc welding electrodes.

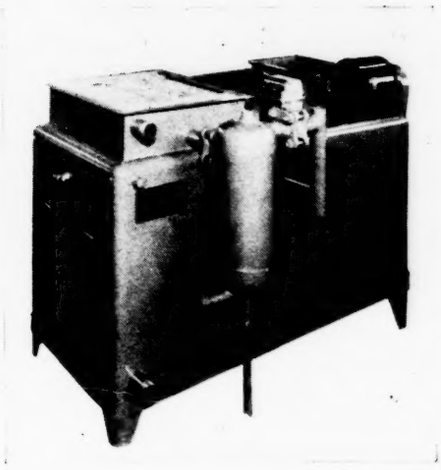
PURPOSE—Electrodes for arc welding.

FEATURES—Line of electrodes comprises five knurled type wires and five flux impregnated tapes. They are designed for flat position operation and for welding from thin gauge sheet metal to axle housings. Electrodes are available in several diameters and alloy analyses.

MADE BY — *Wilson Welder and Metals Co., Inc., 60 East 42nd St., New York 17, N. Y.* **246**

Condenser

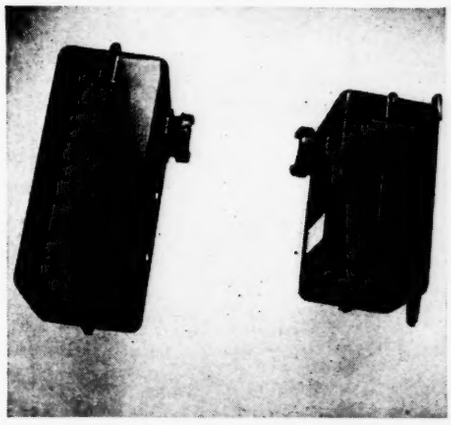
NAME — Niagara Bantam model Aeropass condenser.
PURPOSE—Condenser for use with small refrigeration systems.
FEATURES—Using the spray water principle, refrigerant is condensed with very low consumption of condenser water. Unit removes 1000 Btu from the refrigerant for every pound of water evaporated. The oil-out is located between the dry coil



and the sprayed coils so that oil is removed from the system at the point where it tends to separate naturally.
SIZES AND CAPACITIES — Available for refrigeration systems of from 2 to 7 tons rating.
MADE BY—*Niagara Blower Co., 405 Lexington Ave., 3117 Chrysler Bldg., New York 17.* **247**

Smoke Control

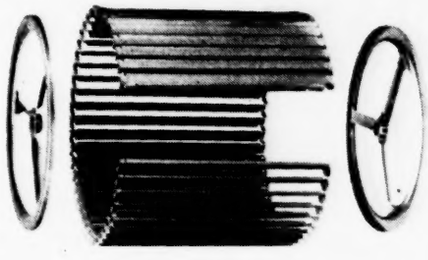
NAME — Photoswitch photoelectric smoke control.
PURPOSE—A safeguard to insure that smoke will not exceed a pre-set smoke value.
FEATURES—Unit indicates the density of smoke passing through the flue or breaching and signals when this density approaches values prescribed by municipal smoke ordinances. Device basically consists of a photo-electric control and light source mounted on opposite sides of the flue. A light source beam is projected across the flue on to the photoelectric control. A sensitivity adjustment permits the equipment



to be so set that it will signal when the smoke density approaches the pre-set value. Supplementary equipment includes bell alarms to signal excessive smoke, densometers to give continuous indications of smoke density, and recorders to record the time of day at which excessive smoke conditions existed at the start.
MADE BY—*Photoswitch Inc., 77 B'way, Cambridge 42, Mass.* **248**

Blower Wheel

NAME—Utility Appliance Co. blower wheel.
PURPOSE — Wheel is of resistance welded, five-piece construction with blades stamped from continuous steel strip. Blade width is proportioned to each wheel diameter. Dual



drive, with hubs at each end, distribute wheel weight close to the bearings and the dual drive permits increased power input that is necessary for higher wheel speeds. Blades are turned for junction with the end rings with a large radius to increase the resistance of the metal. The end ring is designed with a venturi section throat for smooth air flow. Spokes are made very rigid to withstand maximum torsional stresses in use.
MADE BY—*Utility Appliance Corp., Los Angeles, Calif.* **249**

Variable Pitch Pulley

NAME—Central variable pitch pulley.
PURPOSE—For fractional horsepower drives.
FEATURES—Pulleys are designed for accurate balance and felt grooves are cut to give a strong grip and silent operation. Speed variations of about 30% are

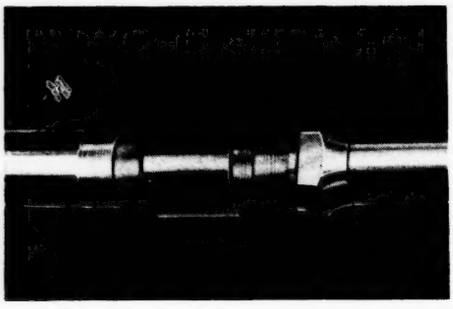
claimed by including a variable pitch pulley in the drive, and variations of about 500% by using both pulleys of this type and interchanging them on the motors and driven shafts.
SIZES AND CAPACITIES—For following V-belts: 0-⅜ in.; A-½in.; B-⅝ in. Bore diameters, ½ to 1 in.
MADE BY—*Central Die Casting and Mfg. Co., 2935 W. 47th St., Chicago, Ill.* **250**

Electrodes

NAME—Stainless steel electrodes.
PURPOSE — For welding stainless steel.
FEATURES—Electrodes, in a full range of grades and diameters, are also designed with two types of coatings—one for a-c or d-c use, and the other for reverse polarity d-c operation. Electrodes can be used in all welding positions. Deposition characteristics are said to assure flat fillet welds.
MADE BY—*General Electric Co., Schenectady, N. Y.*.....**251**

Stainless Steel Fitting

NAME—Esco P-T adapters.
PURPOSE — For joining stainless steel piping and tubing in an easily assembled joint.
FEATURES—Fitting makes possible the incorporation of stainless steel tubing in take offs from standard



piping layouts. Where tubing would be satisfactory, it avoids the use of the more expensive stainless steel pipe. Tubing is butt welded to the adapter and thus is permanently fitted with standard pipe threads.
MADE BY—*Electric Steel Foundry, 2141 N.W. 25th Ave., Portland 10, Ore.* 252

Low Pressure Switch

NAME—Cook LP low pressure switch.
PURPOSE—To control electric circuits actuated by extremely low pressures or vacuums, either liquid

or gas. Applications include those with low pressure blower systems, and other places where small differentials in pressures must be detected.
FEATURES — Copper flashed steel frame, electro-tin plated to resist corrosion. Actuating bellows of tinned phosphor-bronze.
SIZES AND CAPACITIES—Pressure connection—⅛ in. standard female pipe thread. Operates at pressures from 0 to 30 in. of water pressure, vacuum, or both. Normal value of pressure differential between on and off position may be specified anywhere between 0.3 and 10 in. water pressure.
MADE BY—*Diaphlex Division of Cook Electric Company, Chicago 14, Ill.* 253

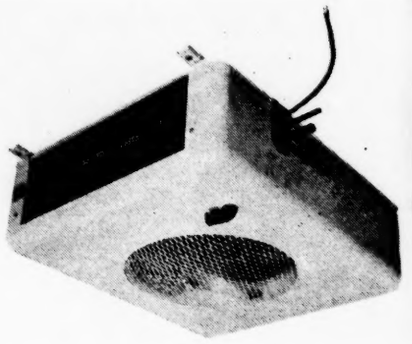
Fan-Heater

NAME—Surf season-air.
PURPOSE—For room heating or cooling.
FEATURES — With the housing in place unit becomes a 1320-watt

forced air heater which circulates 140 cfm of warm air. Heating coils are guarded to avoid injury to children. For warm weather, heater housing is easily removed and unit operates as a 10-in., three-blade fan delivering 500 cfm. Unit weighs 9 lb, 6 oz.
MADE BY—*G-M Laboratories Inc., Chicago, Ill.* 254

Air Circulator

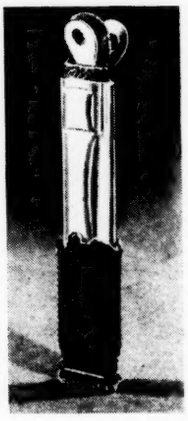
NAME—Spasaver.
PURPOSE—Refrigeration of walk-in boxes, and similar applications above 34F.
FEATURES—Designed to take up a minimum of space and induce circulation. Engineering features include exact liquid distribution to each of two coils, balanced primary and secondary heat transfer area, accurate capacity evaluation, and free accessibility of interior. Unit has formed metal housing with baked white Dulux finish. All F-12 and methyl units are equipped with



d-h Hexchanger heat exchangers. Ammonia units are also manufactured.
SIZES AND CAPACITIES—Units come in 13 sizes with capacities from 90 to 2490 Btu per F difference.
MADE BY—*Drayer-Hanson, Inc., Los Angeles 21, Cal.* 255

Thermostat

NAME—Master-Mite thermostat
PURPOSE—Temperature control.
FEATURES—Thermostat is furnished preset by the manufacturers up to a temperature range of 550F and is available either normally closed or opened. Unit has a capacity up to 1500 watts. Slight wiping action of the ¼-in. fine silver points is said to result in long life of contacts. Thermostat is completely jacketed in aluminum, copper or nickel and is insulated with silicon impregnated fiberglass. Unit measures ¼ in. by ½ in. by 2½ in.



MADE BY—*Mechanical Industries Production Co., 218 Ash St., Akron 3, Ohio.* 256

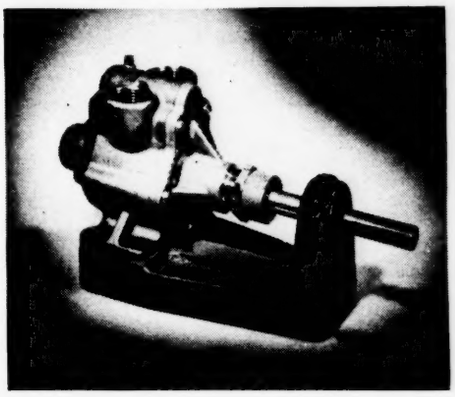
Electric Home Furnace

NAME—Electromode home furnace.
PURPOSE—Space heating in homes by electric power.
FEATURES—Furnace has a rated capacity of 4156 watts per heating element. Forced air circulation is obtained with a fan rated at 1,400 cfm and is driven by a ¼ hp motor. An air filter is located in the cold air duct. Furnace has humidity control equipment. Moduflow motor, controlled by exterior and interior thermostats, meters the power to the six heating elements. Furnace can be installed in a house

without a basement, chimney or flue.
SIZES AND CAPACITIES—Comes in two sizes—one for home of 8-12 rooms containing 24,000 cp ft of room space, and the other for homes up to 11,000 cp ft. Each unit is 48 in. high.
MADE BY—*Electromode Corp., Rochester, N. Y.* **257**

Gearless Pump

NAME — Eco one inch gearless pump.
PURPOSE—Gearless pump for the circulation of water, light oil, or other liquids.
FEATURES—Pump uses double impellers made of several layers of a pressure vulcanized laminated material. A built-in drive shaft bearing and base eliminate side-pull when the pump is powered by a belt-drive and pulley. It is claimed



that this bearing will reduce wear caused by unnecessary vibration. Pumps can be mounted at any angle and can pump in either direction.
SIZES AND CAPACITIES — Capacity varies from 7.5 gpm at 600 rpm to 23 gpm at 1800 rpm. Overall dimensions with 1 in. connections are 10½ x 4¼ x 5¾ in.
MADE BY—*Eco Engineering Co., 12 New York Avenue, Newark, New Jersey* **258**

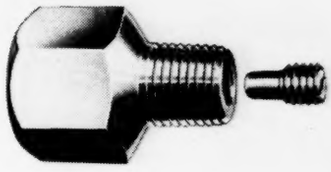
Servo Motor

NAME—Servo model 2A motor.
PURPOSE—Compact low inertia motor for remote control applications.
FEATURES—Does not run on single phase and fixed phase may be con-

tinuously energized. Can be wound to operate from 10 to 80 volts, 60 cycle. Impedence practically constant from full speed to stall. Unit is midget sized device that fits inside one's hand.
LITERATURE AVAILABLE — Bulletin and performance charts.
MADE BY — *Transicoil Corp., 114 Worth St., New York, N. Y.*.....**259**

Snubber

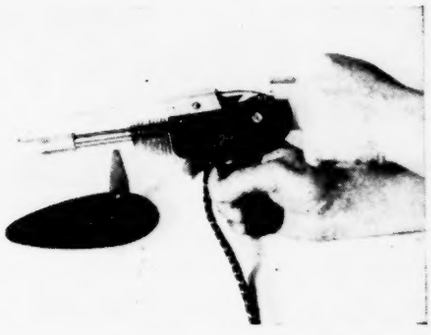
NAME — Helicoid pulsation dampener.
PURPOSE—Dampening pulsation.
FEATURES—Device employs the use of powdered metal through which the pressure medium must pass. Compressed powdered metal in the form of a cartridge can be inserted directly in the gage socket or in a small separate connecting piece attached to that socket. Compressed



powdered metal is made in various porosities for air, gas, water, steam or oil.
MADE BY—*Helicoid Gage Division, American Chain & Cable Co., Inc., Bridgeport 2, Conn.* **260**

Soldering Iron

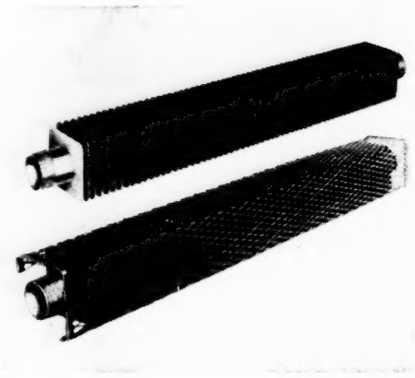
NAME—Eject-O-Matic.
PURPOSE—Automatic type soldering iron with automatic feed from a spool of core solder.
FEATURES—Gun is designed for production soldering. In the handle there is space for a spool of core solder which is fed automatically to the tip by pulling a trigger. The amount of solder fed with each pull



of the trigger can be regulated by adjusting wheel that is built into the handle.
MADE BY—*Multi-Products Tool Co., Newark, N. J.* **261**

Fin Pipe

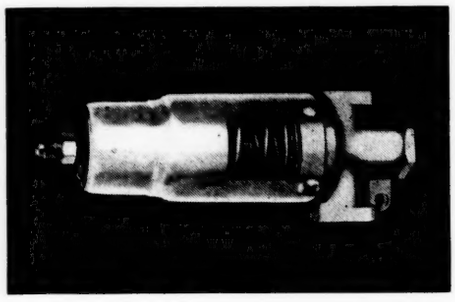
NAME—Standard fin-pipe radiator.
PURPOSE—Space heating or air conditioning.
FEATURES — Radiators are constructed of standard weight steel pipe. Fins are of heavy gauge steel and are bonded to the pipe. Grille is constructed of heavy expanded mill steel and is furnished in 12 ft lengths. Grilles are snapped on around the radiators and are held securely in position. Weight of grille is ½ lb per lineal foot for



1¼-in. pipe size, and ¾ lb for the 2-in. size. Grilles reduce the ratings of the radiators by 10%.
MADE BY—*Standard Heat & Power Co., 470 Main St., Clinton, Mass. Distributed by U. S. Radiator Corp., Detroit 31, Mich.* **262**

Regulating Valve

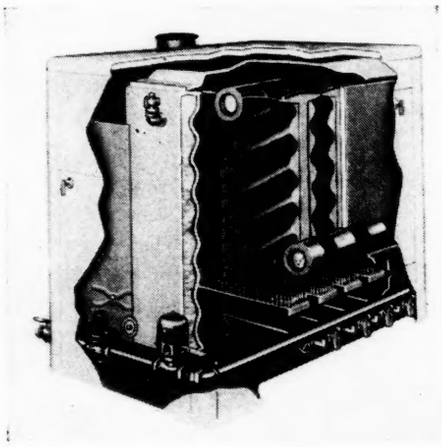
NAME—A-P water regulating valve, model 68-B.
PURPOSE—For accurate control of water flow to water-cooled condenser units.
FEATURES—Valve employs a molded composition seal on the valve stem and this seal moves across a polished stainless steel seat to provide a self-cleaning wiping action. Because of this design makers claim the valve seat does not have to be replaced. The stroke provided by this valve design results in uniform control. Water flowing through the condenser unit is regulated by head or receiver pressure which actuates a heavy duty bellows in the top of the valve and this in turn moves the sliding valve stem and seal. The



valve has an operating head pressure range of from 50 to 150 lb per sq in. Adjusting nut is easily accessible and a drain plug at the base permits valve flushing.
SIZES AND CAPACITIES.— Available in ⅜, ½ and ¾-in. inlet and outlet sizes.
MADE BY—*Automatic Products Co., 2462 No. 32nd St., Milwaukee 10, Wis.* **263**

Gas Boiler

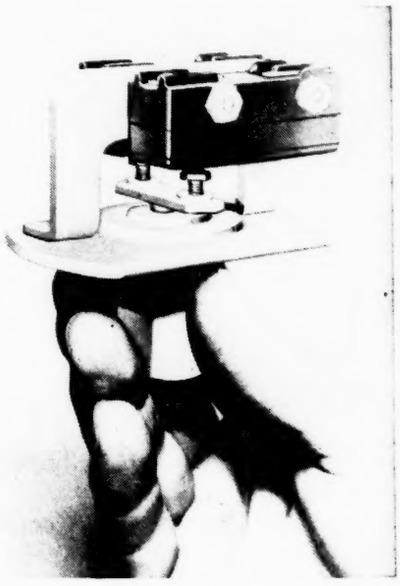
NAME—Capitol gas boiler, series 22.
PURPOSE—Space heating.
FEATURES — Boilers are made up of cast iron sections. An assembly



consists of two end sections, and a number of intermediate sections. Automatic secondary air control is provided by a special damper door in the jacket casing operated by the gas motor valve. Door opens when burner is on so that air can pass into the air space inside the jacket, over the top of the boiler and into the firebox. Entering air is thus preheated. When burner is off, the secondary air door is automatically closed. Equipment supplied with boiler includes draft diverter hood, gas pressure regulator, main gas valve, motor gas valve and transformer, safety pilot, and auxiliary lighter pilot and gas cock.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*United States Radiator Corp., Detroit 31, Mich.* **264**

Differential Switch

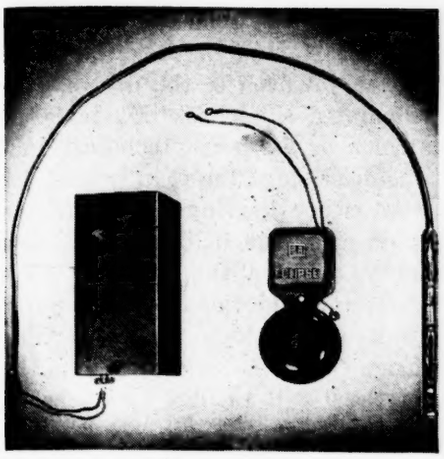
NAME—Cook ID industrial differential switch.
PURPOSE — Wherever two circuits need independent control at equal



or different pressures. For example, circuit *A* can be set to operate an on-off device for normal operation and circuit *B* operates an alarm or cut-off when excessive pressures are reached. Specific example of application is electrically operated steam heaters where circuit *A* operates a fan and circuit *B* controls a heating element.
FEATURES—Bellows of Tinned phosphor-bronze, frame cadmium plated.
SIZES AND CAPACITIES—Pressure connection ¼ in. standard female pipe thread. Either circuit may be supplied to operate on pressures from 1 to 17 lb per sq in. or pressure differential specified anywhere between 1 and 10 lb per sq. in.
MADE BY — *Diaphlex Division of Cook Electric Company, Chicago 14, Ill.* **265**

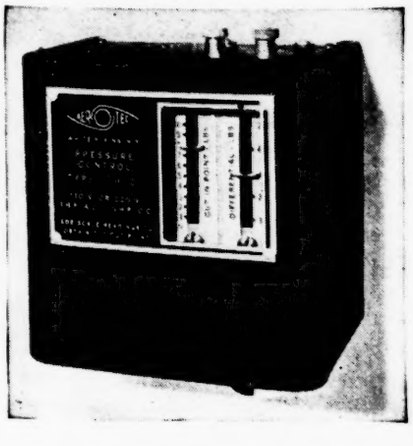
Temperature Alarm

NAME—Zerostat automatic temperature alarm.
PURPOSE — An alarm indicator for refrigerated areas.
FEATURES—Device warns of a temperature rise. If the temperature within a refrigerated compartment becomes excessive through faulty operation of the refrigerating mechanism the alarm bell sounds.
MADE BY—*Electric Glass Co., 249 No. 4th St., Phila. 6, Pa.* **266**



Switch

NAME — Aerotec switch, series H-700.
PURPOSE—Pressure switch for control of gas, oil or coal-fired steam boilers.
FEATURES—Control is easily set by fingertip adjusments from outside the cover. Calibrated scales for range and differential are read through a window in the cover. While the first model in this series is for a range of from 1 to 10 lb with a differential of from 1 to 5 lb, higher pressure limits are available. The H-700 model will handle any liquid or gas not injurious to brass.
MADE BY—*Aerotec Co., Distributed by Thermix Corporation, Greenwich, Conn.* **267**



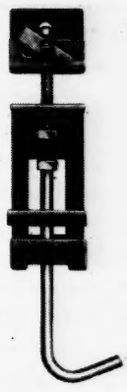
Featherweight Isolator

NAME—Barry type 275 Featherweight vibration and shock isolator.

PURPOSE—For isolating exceptionally low weight loads.
FEATURES—Device requires punching of only one small hole in unit for each mount. Priced to compete with rubber grommets and simple coil springs. Isolates vibration frequencies as low as 15 cps in all directions with resonances as low as 9 cps. Said to give full isolation for loads as light as 5 oz per mount, but same sizes can be used for loads up to 3 lb per mount.
MADE BY—*L. N. Barry Company, Inc., 179 Sidney Street, Cambridge 39, Mass.* **268**

Radiator Bracket

NAME—Capital All Purpose radiator bracket.
PURPOSE—For supporting radiators of various sizes from wall.
FEATURES — Design permits the radiator supporting hook to swing in a vertical plane at right angles to the wall, to accommodate radiators of various widths. Combination of the saddle and bearing plate allows the hook to be moved into a position for easy application without loosening the attaching bracket. Vertical adjustment for grading or leveling is done by the bolt at the head of the bracket.



MADE BY—*United States Radiator Corp., Detroit 31, Mich.* **269**

January, 1947

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

243	244	245	246	247	248	249	250	251
252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269

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NEWS OF THE MONTH

BROAD PROGRAM

of education and research reviewed by I-B-R-members at annual meeting.

Reports indicating the expansion of the research, educational, and promotional activities of the Institute of Boiler and Radiator Manufacturers on a broad front were received at the annual meeting of the members and associate members in Atlantic City, October 15, 16, and 17. Several international members of the institute representing Canadian manufacturers of boilers and radiators were in attendance.

• **OFFICERS.**—Carrol M. Baumgardner of Detroit, executive vice president of the United States Radiator Corp., was elected chairman of the institute, succeeding A. E. Bastedo of Irvington, New York, president of the Burnham Boiler Corp.

H. S. Washburn, chairman of the Board, H. B. Smith Co., was elected vice-chairman of the institute, and R. E. Ferry was re-elected treasurer.

• **PROJECT.**—What will be the first installation of radiant baseboards in a pre-fabricated basementless house was approved as a research project by the members of the institute. The installation will be made at the University of Illinois and the study of the performance of the radiant baseboards will continue over a period of two years.

The new project is part of the long-range research program of I-B-R which has been underway at the University of Illinois since 1940. The object of this program is to study all types and applications of hot water and steam heating systems under varying operating conditions.

• **PROGRAM.**—S. K. Smith, chairman of the research committee, referred to the expanding scope of the I-B-R research program and to important results which already have been achieved since its inauguration in 1940. Mr. Smith, who is president of the H. B. Smith Co., stressed the significance of the findings of the I-B-R research program to all who have an economic interest in the sale of everything entering into a complete hot water and steam heating system.

A detailed report on current research activities and plans for 1947 was made by Warren Harris, special research associate professor, College of Engineering, University of Illinois. The report by Professor Harris was supplemented by comments by Maurice Fahnestock, Professor of Mechanical Engineering, College of Engineering, University of Illinois.

Professor Harris said that the installation of Type RC radiant baseboard had been completed in the I-B-R Research Home. A two-pipe reverse return gravity hot water system has been installed. Previously a study was made of the operating characteristics of the Type R radiant baseboard.

Progress has also been made in the work in the laboratory preliminary to the development of a testing code for radiant baseboards, Professor Harris declared. He also outlined the activities of the research sub-committee on water heating in the development of a standard method for testing and rating water heaters.

• **PAPERS.**—A paper on "Temperature Controls for Hot Water Heating Systems" was read by W. W. Martenis of the Minneapolis-Honeywell Regulator Co. Some of the basic factors involved in the proper location of controls were pointed out by Mr. Martenis.

L. N. Hunter, chairman of the boiler technical committee, reported on the deletion of the requirement for fusible plugs in low pressure heating boilers in the Massachusetts rules; on a change in the ASME code affecting water relief valves; on the proposed commercial standard for testing and rating of hot water supply boilers; on gas-fired ratings for convertible boilers; on I-B-R ratings for large boilers; and on the proposed extension of the I-B-R ratings to smokeless boilers.

Mr. Hunter, who is vice president of The National Radiator Co., recommended on behalf of the committee that "where there are no radical changes in smokeless boilers, the hand-fired ratings for similar boilers may be approved for the smokeless type."

Mr. Ferry reported that the Joint Convector Code Committee consisting of representatives of manufacturers of ferrous and non-ferrous convectors has completed the details of a proposed commercial standard covering the testing and rating of cast iron and non-ferrous convectors. This step, Mr. Ferry pointed out, marks the completion of a job which has been worked on by the Committee since 1941.

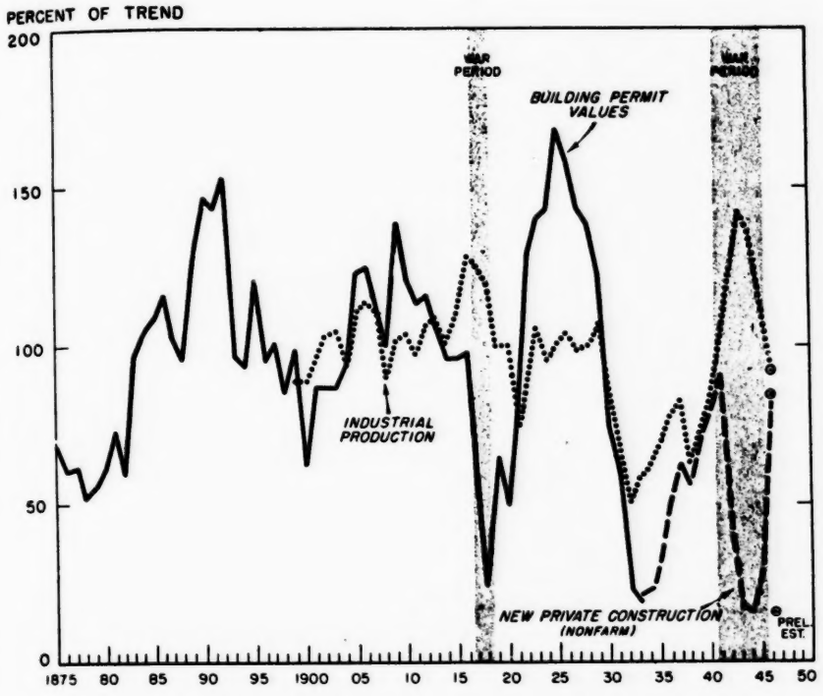
Mr. Ferry also told the members of the Institute that the manufacturers of convectors have under consideration a proposed simplified practice recommendation for convectors which would reduce the number of sizes and types to approximately 200 in contrast to the extremely large number of sizes and types which were made prior to the war.

A report on consumer publicity for radiant heating was made by Norman J. Radder, secretary of the Plumbing and Heating Industries Bureau.

BUSINESS CYCLES

are related to construction activity, according to Department of Commerce.

Fluctuations in construction activity affect general business activity because construction is itself a major component of general business, and because its activity has reprecussions upon other components of general business. However, the fluctuations of general business activity do not necessarily run in phase with those of construction activity, according to a U. S. Department of Commerce report in the November Survey of Current Business.



New, private, non-farm building and industrial production, expressed as a percent of long-term trend.

• **PHASE.**—General business activity has been found to fluctuate in a major cycle of from 6 to 12 years, averaging somewhat over 8 years. Superimposed on these major cycles are minor business cycles of short duration generally within a range of three to four years. The major cycles in construction activities, however, have a length of from 16 to 19 years, and average between 17 and 18 years. Construction also is subject to minor cyclical fluctuations. Such minor cycles reflect general business conditions which somewhat affect the course of construction activity, but the major swings of the construction cycle appear to be largely unaffected.

• **CONTRAST.**—While the difference between peak and trough of the general business cycle has diminished in recent years, the construction cycle shows sharper differences, and its decline from peak to trough is 50 to 70% so that construction activity at its peak is two or three times that of the trough.

Owing to the difference in timing of cycles, there is a tendency for about half of the business booms to be somewhat accentuated by construction booms as appears to have been the case in the 1920's, while other business booms attained relatively low peaks, owing to the insufficient responsiveness of a depressed construction industry, as during the business recovery of 1933 to 1937.

• **WAR PERIODS.** — The present post-World War II situation of both construction and general business is at least in part analogous to the post-World War I situation. Prior to World War I construction had reached a peak in 1909 so that construction of buildings declined to a trough by 1918.

While the war may have helped determine the precise time of the low point, past experience indicated that a low point was to be expected at about that time in any event. After World War I demand for building products had again absorbed available stocks and a construction boom developed. Reaching a peak in 1926 and throughout most of the '20's the buoyancy of construction aided in bringing other factors of business to a prosperous level. The great depression of the 30's was prolonged by the decline in construction activity after 1927. World War II apparently interrupted the upward swing of a construction cycle and construction was forced to wait; but the pre-war shortages that had been about to generate a construction boom will probably carry on into the post war period so that construction will tend to boom in the immediate post war period.

• **OUTLOOK.** — There is some evidence in the recent decrease in the volume of real estate transfers, in the recent apparent tendency towards stability of prices of residential property, and in the increasing discussion of deferment of industrial and commercial construction that further large increases in construction costs might lead to at least a temporary decrease in demand. Such a decline would probably be particularly noticeable in residential construction. However, if the building of dwellings should decrease as a result of higher costs, the slack in activity might be taken up—at least in 1947—by private commercial and industrial buildings.

In assessing the effect of a possible general business recession, it has been assumed that such a recession would be neither severe nor long lasting enough to affect employment and incomes to any great extent. The strength of the underlying construction situation appears to be a guarantee against a major depression of this nature in the period ahead.

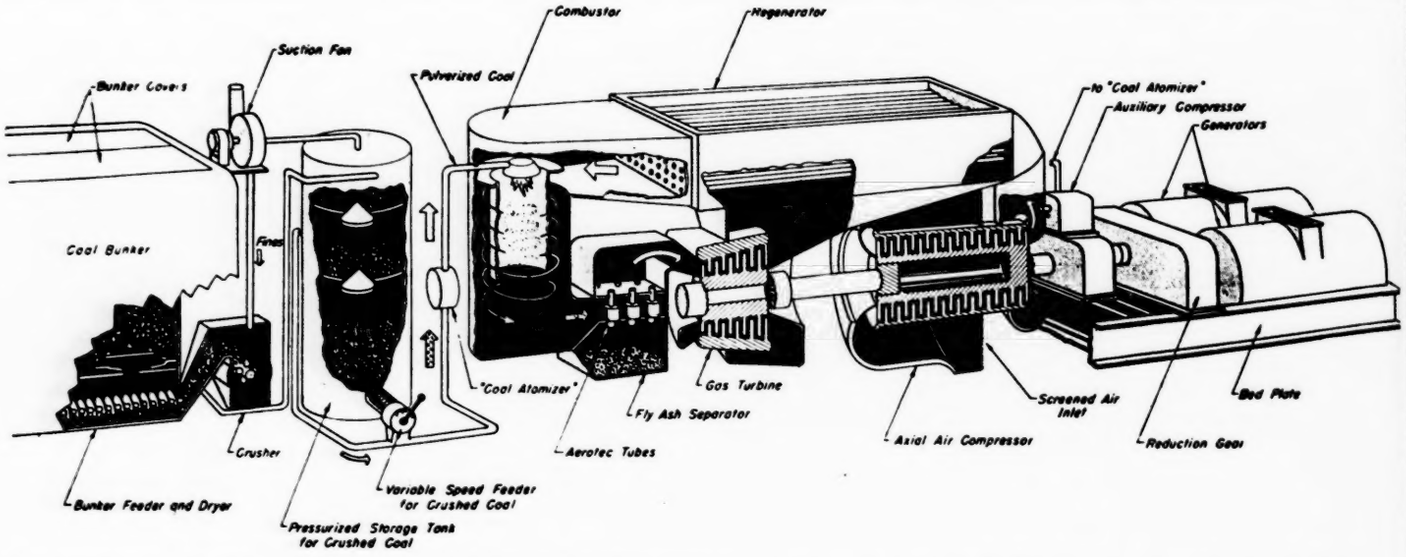
FULL SCALE MODEL

of coal burning turbine equipment for locomotives is scheduled by BCR.

The BCR locomotive development committee has announced a complete schedule of work that will place revolutionary new coal-fired locomotives on the rails for test in 20 months. Objective, according to B & O's Ray B. White, committee chairman, is to build two high speed double ended locomotives of 3000 rail horsepower each with 1000-mile on-stop fuel capacities.

• **TURBO-GENERATORS.**—To power these locomotives two gas-turbo-generator units have been ordered, one from Allis-Chalmers and the other from the Elliott Company. Chassis for the power plants are being developed independently by American Locomotive, Baldwin, and Lima Locomotive works.

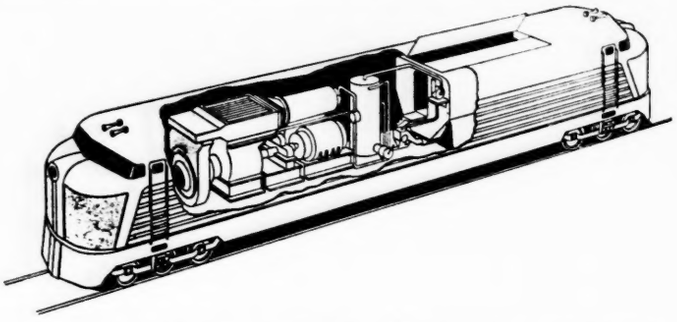
• **PERFORMANCE.**—The gas turbine locomotives are expected to burn less than 1000 pounds of coal per rail



Cut-away diagram of coal-handling, combustion and turbo-generator system using the Allis-Chalmers gas turbine and generator.

horsepower hour; use very little lubricating oil; need no water except for train heating boilers; require less maintenance than steam or diesel locomotives; and have an availability equal to that of diesels.

• **FEATURES.**—Finished locomotives will take prepared coal up to about 4 inches in size from bunkers, convey, dry and crush it to a 16 mesh top size. The coal will then be delivered to a hopper or pump directly



A possible design for a 3,000 hp, coal-burning, gas-turbine locomotive. The Elliott turbine is shown in this unit.

to a coal atomizer where it is reduced to size to 90%-325 mesh. Coal is then delivered to combustors under pressure where it will be burned at 70 lb per sq in. with air heated in regenerators to 600F.

Gases will be freed of fly ash in a battery of Aerotec cyclone separators before entering the turbine at 1300F and 68 pounds per square inch. The turbine shaft drives an air compressor and a direct current generator. Power produced in the generator will be delivered to traction motors on the axles. A mechanical transmission drive is also being considered for later development.

• **COMBUSTOR.**—While the turbines are being built, tests will go forward on large-scale coal handling and combustion equipment. Tests of a combustor burning 1000 pounds of pulverized coal per hour at 100 lb per sq in. will be conducted at American Locomotive Company, Dunkirk, New York. Later, full combustion tests of 3000 pounds of coal per hour in one combustor will be carried out in Fontana, California.

• **RESEARCH.**—Various contributory phases of the research program are being carried out at Johns Hopkins University, the Institute of Gas Technology, Battelle Memorial Institute, and Purdue University.

ASRE CONVENTION

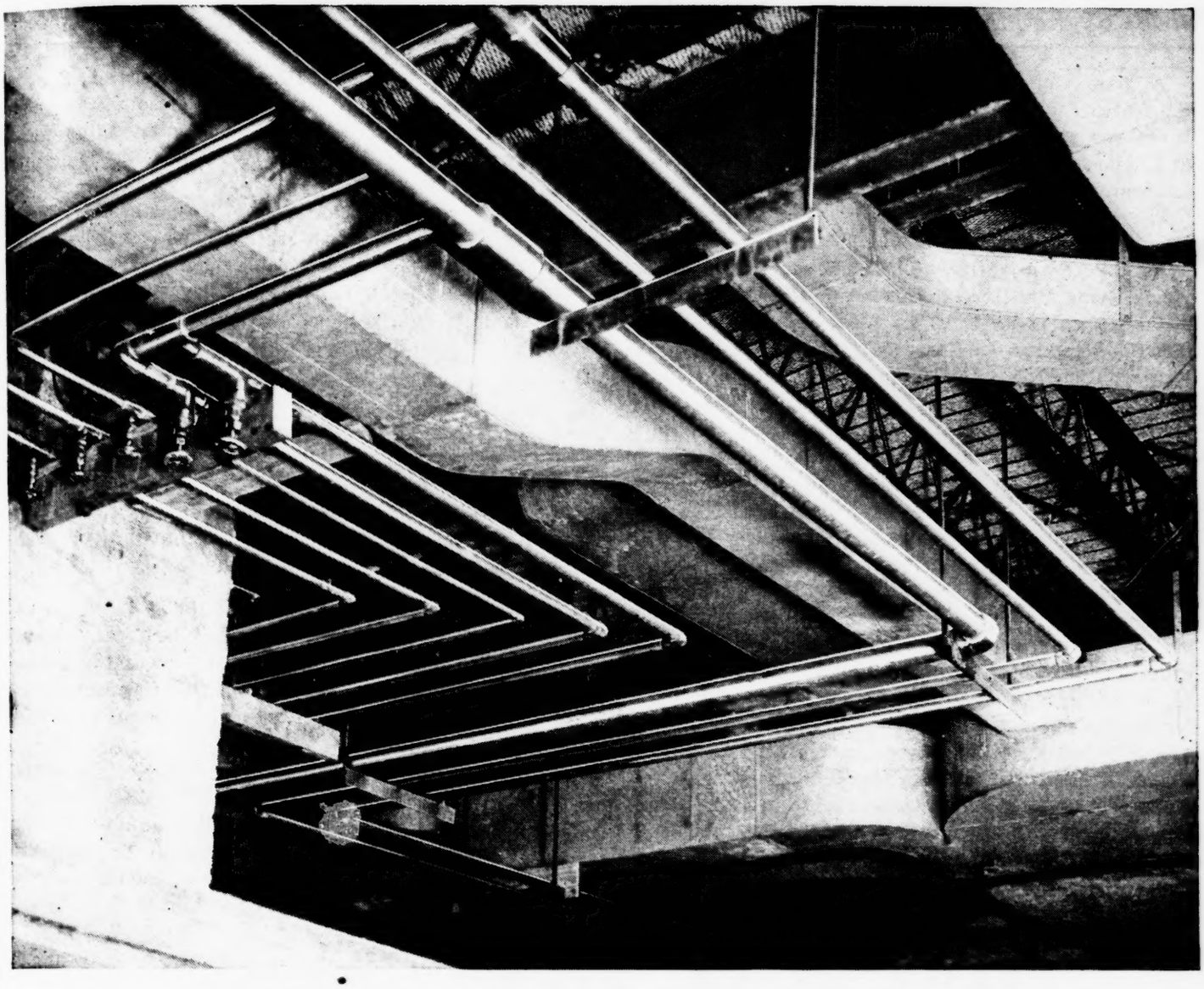
held in New York City. Transportation symposium well attended. Robert H. Money is new president

Nineteen technical papers were presented at the forty-second annual meeting of the American Society of Refrigerating Engineers held at the Hotel Pennsylvania, New York City, December 16-18. Beside the papers which were presented at five tehnical sessions, there were a number of inspection trips and social events. Approximately 750 persons registered at the convention.

• **PAPERS.**—The technical program started with a paper on Progress of Research in Refrigeration, by S. C. Prescott, Professor Emeritus, Massachusetts Institute of Technology. He mentioned some of the engineering projects that were carried on with the help of the Refrigeration Research Foundation, and some of the studies that he thought should be made.

T. K. Sherwood, Dean of Engineering. Massachusetts Institute of Technology and W. M. Simpson, Servel, Inc., presented a paper on "Performance of Small Mechanical Draft Cooling Towers." The paper included a large amount of tests data and information on typical commercial cooling towers.

Low Pressure Liquefaction of Air was described by J. Henry Rushton, Director, Department of Chemical Engineering, Illinois Institute of Technology. It is expected that in the near future in this country, large amounts of oxygen will be produced by low pressure air liquefaction techniques. The equipment and the liquefaction process are described.



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A paper on Thermodynamic Properties of the Saturated Liquid and Vapor of Ammonia-Water Mixtures was prepared by George Scatchard, Department of Chemistry, M.I.T.; L. F. Epstein, Crystal Research Laboratories; James Warburton, Jr., M. W. Kellogg Co.; and P. J. Cody, Solvay Process Co. A number of important tables, were included.

As the result of research work carried on at the Engineering Experiment Station of the University of Minnesota, a paper on Low Mean Temperature Thermal Conductivity Studies was presented by Frank B. Rowley, Richard C. Jordan and Robert M. Lander, all of the University of Minnesota. Included were a summary of thermal conductivities for various insulating materials at six mean temperatures and graphs to show results of various insulating tests.

A paper on Condensation of Freon-12 with Finned Tubes by Donald L. Katz, Ralph E. Hope, Steve C. Datsko and Donald B. Robinson of the University of Michigan, was divided into two parts. The first part was on single horizontal tubes and the second part on multitube condensers. The studies were to determine experimentally heat transfer coefficients which would serve as the basis for predicting the size of condensers for Freon-12.

• **SYMPOSIUM.**—At a transportation symposium, D. F. Fisher, Principal Horticulturist, U. S. Department of Agriculture, Washington, D. C., made the introductory remarks and outlined some of the existing problems. He showed some of the equipment used in making temperature studies in refrigerated cars.

Construction of Railway Refrigerator Cars was described by R. G. Setzkorn, Mechanical Superintendent, American Refrigerator Transit Co., St. Louis, Mo.

John W. Kelley, United Fruit Co., New York, N. Y. spoke on Improving Refrigerating Cars. He reported that studies are now in progress by a cooperating engineering group on the advisability of changes in standard railway car construction.

Henry O. Kirkpatrick, Chief Engineer, Advance Manufacturing Co., Detroit, described a modern refrigerating unit for Motor Transport Refrigeration. While at the present refrigerator units for trucks have a capacity of from one to two tons, the future trend will be towards units of from three to five tons capacity,

H. E. Parker, Engineer, Central Technical Department, Shipbuilding Division, Bethlehem Steel Co., Quincy, Mass., prepared a paper on Cargo Refrigeration. He described the refrigerating load and various systems of refrigeration employed.

Refrigerating Requirements Aboard U. S. Vessels were described by Commander C. V. Hawk, Bureau of Ships, U. S. Navy, Washington, D. C. It was primarily concerned with ship store refrigeration aboard U. S. Navy vessels.

Other papers presented were directly concerned with the technique of frozen foods or food handling.

• **OFFICERS.**—New officers of the society are Roland H. Money, president; Clifford F. Holske, vice-president; Burgess H. Jennings, vice-president; Paul B. Christensen, Treasurer.

• **AWARD.**—C. E. Lund, Director of Research, Seeger Refrigerator Company, St. Paul, Minnesota, was given the Wolverine Award for the most outstanding technical publication for the year in "Refrigerating Engineering."

R. H. Swart, a member of the Central New York Section received the best section paper award for his paper on Capillary Tube Heat Exchangers.

A life membership in the ASRE was presented to Harry T. Whyte, formerly with the Pacific Fruit Express Co., San Francisco, Calif.

RAILROAD PASSENGER CARS

show considerable reduction in weight of air conditioning and heating equipment. Further reductions believed possible.

When one considers that the weight of heating, cooling and electrical equipment in a modern self-powered railroad coach represents from 11.5 to 16.1% of the total car dead weight, the problem of the importance of keeping down the weight of such equipment becomes readily apparent.

For that reason, a symposium of twelve papers on weight reduction in passenger car equipment and specialties was presented at the 1946 annual meeting of the American Society of Mechanical Engineers in New York City, December 12. Four of the papers were concerned with the reduction of weight in heating and air conditioning equipment.

• **CHANGES IN DESIGN.**—In a paper by Edward A. Russell, vice-president, Vapor Car Heating Co., Chicago, it was pointed out that the weight of heating specialties, radiation, pipe and fittings was reduced from 3059 lb in 1925 to 1332 lb in 1945. The early radiation design consisted of five runs of standard cast iron pipe on each side of the car; this was changed to steel fin pipe using two runs of pipe on each side of the car. At present the cars have one length of radiation on each side of the car using copper fin pipe. The advent of longer trains brought about an increase of from 2- to 2½-in. steam connections.

Although there has been an increase in weight in wash water heating specialties due to additional wash water heating facilities from 1925 to 1937, figures show that for the entire car, there has been a reduction in weight of 56% from 1925 to 1945.

• **ALUMINUM PARTS.**—The use of light weight alloys, including aluminum would perhaps require thicker wall sections and special heat treatment to provide the proper tensile strength under high temperatures.

On the other hand, the use of aluminum for certain parts of refrigeration and air conditioning equipment would result in a reduction of 575 lb in dead weight, according to George E. Hulse, Chief Engineer, The Safety Car Heating and Lighting Co., Inc. The Aluminum Company of America believes that aluminum can be safely used for refrigerating unit frame,

No matter how well you build Your Product ... if its performance depends on temperature or pressure control... that product can be no better than the controls with which it is equipped

WHITE-RODGERS ELECTRIC CO.
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Controls for Refrigeration • Heating • Air Conditioning

refrigerating unit casing sheets, cold water piping inside car, air conditioning unit coils and air conditioning unit casing. If expense is not to be considered, an additional reduction of 75 lb can be obtained by redesign.

• **COMPRESSOR SPEEDS.**—Development in compressor design has made it possible to increase the speed of the compressor by a factor of almost three-to-one so that for equipment of 8 tons refrigeration, a weight saving of 225 lb will result.

New designs are based on separate compressor and condenser units as against enclosing them in a single casing. This change, in many cases, will save about 150 lb.

In contrast to this, L. McCutcheon, of the Frigidaire Division, General Motors Corporation in his paper on air conditioning equipment, reported that it has been the experience of his company to use relatively slow speeds because speeds have a direct relationship to efficiency and reliability.

To achieve greater flexibility in locating Frigidaire equipment, the condenser has been separated from the compressor unit. This resulted in a weight reduction of 100 lb.

• **WEIGHT AND POWER.**—H. H. Hanft, transporation engineer, Westinghouse Electric Corp., in his paper. "An Analysis of Weight Reduction in Modern Railroad Passenger Car Electrical and Heating Equipment," said that during the past decade, standard railroad passenger cars have been reduced in weight to 100,000 lb. Since the structural shell of a modern car is about 30,000 lb, railroads are very much interested in reducing the weight of heating and air condition equipment, battery and car supply items.

By removing the source of electric power from the car and placing it at the head end of the train, heating and air conditions functions can be performed by equipment weighing but 7,577 lb. If head end a-c power is used, car equipment weight is reduced to less than 9% of total car weight as against a possible 16%.

The a-c car is heated by electric space heaters and an overhead hot water engine jacket water heating coil. Cooling equipment weights include from 130 to 155 gallons of evaporative condenser or steam jet water supply.

He believes that substantial weight economy can be achieved through the use of high strength steels and lightweight alloys in equipment structures and refrigerant circuits.

HOW TENANTS FEEL

brought out in survey which shows more object to owners' attitudes than to physical factors.

A study of 2,065 tenants in 26 apartment houses, conducted by Carlisle Davidson, public relations consultant to the Real Estate Board of New York, and reported by Russell Porter in "The New York Times," showed that more people complain of main office attitudes than complain of actual physical deficiencies such as lack of heat, hot water, elevator service, etc.

• **COMPLAINTS.**—Tenants were asked to check three in a list of sixteen items to indicate which shortcomings should be corrected first. The results follow:

	P.C.
Attitude of main office in dealing with tenants	36.3
Promptness in performance of promised special services	25.7
Attitude of superintendent	23.0
Speed in effecting minor repairs, such as burnt-out fuses, plumbing leaks, etc.	21.2
Appearance of entrance foyer, corridors, elevator cabs	17.1
Smoke from incinerators when windows are open	16.7
Elevator service	12.0
Noise by other tenants	9.6
Noise from piping and other mechanical equipment	8.4
Appearance of building exterior	8.1
Noise in removal of garbage or ash cans	7.1
Personal appearance of building service employes	7.1
Exclusion of peddlers and other intruders	5.7
Handling of mail, deliveries, etc.	5.5
Heat	5.5
Hot water	3.1

Also included were the following questions, with figures showing how they were answered:

"In general, how do you feel about the accommodations you receive in return for the rent you pay?"

	P.C.
Good	40.5
Fair	28.9
Excellent	22.0
Poor	7.7

"Which of these terms best describes your idea of life in a New York apartment?"

	P.C.
Moderately comfortable and pleasant	47.3
Very comfortable and pleasant	45.6
Uncomfortable and unpleasant	3.9

"Taking into consideration increases in cost of operation on one hand and rent ceilings on the other, do you believe the building management is taking all reasonable measures for increasing your enjoyment of your apartment?"

	P.C.
Yes	42.0
No	38.7
Don't know	17.1

"Which of the following comes nearest to giving your idea of the general attitude of the building service employes?"

	P.C.
Very courteous and anxious to serve	43.8
Fairly courteous, not unwilling to serve	42.2
Barely civil, giving minimum service	9.8
Impolite, poor service given grudgingly	1.8

Mr. Davidson said the results indicated that most complaints probably were due to lack of information regarding the difficulties confronted by management in

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But here is something else this gleaming surface means—something more important than good looks. It means resistance to rust, ample protection against the corrosive effects of moisture.

Beneath this lustre Beth-Cu-Loy Galvanized Sheets have a second line of defense against corrosion, a base of copper-bearing steel. Containing 0.20 to 0.30 percent copper they have from two to three times the atmospheric rust-resistance of ordinary steel or iron sheets.

Beth-Cu-Loy Galvanized Sheets are not expensive; they are priced at very little more than ordinary galvanized sheets. This slight extra cost is returned many times in longer life and added customer satisfaction.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Beth-Cu-Loy Galvanized Sheets

BETHLEHEM STEEL

labor and material shortages and higher costs during the last few years. He pointed out that a far greater degree of satisfaction was shown by tenants of the twenty-two houses operated by management agents than in the four operated by owners.

AIR CONDITIONING SHIPS

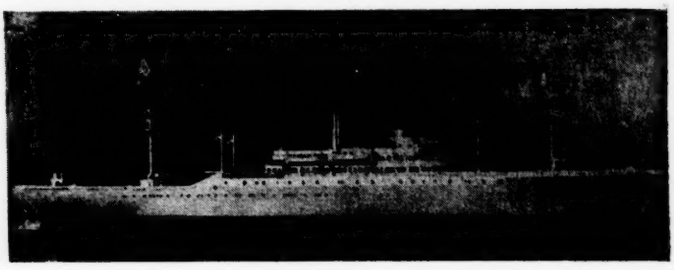
pushed for wartime troop transport proves to be a forward step in luxury and tropical travel.

The air conditioning of seagoing vessels is coming in for its share of attention under impetus of wartime developments in troop transport through tropical waters.

• **AMERICA.** — The reconverted liner America, U. S. luxury queen of the seas, which left New York, November 14, on its first post-war Atlantic crossing, is one of the most completely air conditioned ships afloat. It provides comfort for passengers as well as refrigeration for food supplies and cargo spaces. With equipment furnished by Carrier Corporation, air conditioning machinery serves 199,000 cubic feet in the dining room and other spaces. The central refrigeration plant consists of three, 75 hp, Freon compressors operated by electric motors. Designed for the North Atlantic trade just before the war, the America was taken over by the Government as the "West Point" and served as a troop transport until seven months ago when it was returned to drydock for reconversion.

• **QUEEN ELIZABETH.**—The British luxury liner Queen Elizabeth which recently completed its first post-war trip, has the largest air conditioning installation of its kind installed on any ship. Twelve independent Carrier plants serve this great liner. They provide conditioned air in the rest rooms, first class lounge, salon, first class writing room, studio, first class smoking room, theater, first class hair dressing salon, and beauty parlor, cabin class dining saloon, and cabin class lounge. Twelve plants have a combined capacity of more than 10 million cubic feet per hour. Associated with these is a steam ejector refrigerating machine having a capacity of 5 million Btu per hour. With extreme conditions of 100 dry bulb and 80 wet bulb the plants are designed to maintain an internal temperature of 82F with a relative humidity of 50%.

• **DEL NORTE.**—Two important firsts in maritime and air conditioning history were marked late in November when the new 10,000-ton liner Del Norte sailed from New Orleans to reopen luxury passenger service to tropical east coast ports of South American countries. The Del Norte will be the only completely air conditioned passenger ship on the seas, and will be the first to utilize Carrier's conduit Weathermaster system which provided independent room control of temperatures and humidity. This is the first passenger ship to provide air conditioning throughout the ship for both passengers and crew. A centrifugal refrigeration unit



The S S Del Norte, completely air conditioned

delivers about 130 tons of refrigeration to chill water to about 41F, when operating at about 7000 rpm. For this condition the turbine develops about 130 hp with inlet steam at 170 pounds and 15 pounds back pressure. The refrigerant employed is Carrene No. 2.

Want Catalogs

The St. Louis Office of the Veterans Administration is in need of catalog and engineering data from manufacturers in the field of heating, ventilating, piping, and air conditioning. The address is: Veterans Administration, Technical Section, Engineering Unit, Construction Division, Branch Office No. 9, 420 Locust Street, St. Louis 2, Missouri.

Iowa Sheet Metal Contractors, Inc., Heating Division, 112 Locust St., Des Moines 9, Iowa, is anxious to build up a complete catalog file on air conditioning, heating, and ventilating. Please address catalogs to Paul R. Duitch, Mechanical Engineer.

PRIZE CONTEST ON UNIT HEATER ARTICLES

Subject—Articles on use of steam or hot water unit heaters.

Amount of Prizes—$500.

Eligibility—Any person is eligible to compete in the contest except the staff of the Industrial Unit Heater Association and the Members of the Award Committee.

Articles—Articles shall be submitted or mailed in triplicate, typewritten and double spaced to the Industrial Unit Heater Association, 5-208 General Motors Building, Detroit 2, Michigan. All articles offered become the exclusive property of the Association which may or may not release them to the public.

Subject Matter—Articles shall be written in such a way that they are of benefit to the unit heater industry as a whole and not for the purpose of serving any company or individual. No limit is placed on the scope of the subject matter but awards will be made on those articles which show the advantages of unit heaters in heating industrial and commercial buildings.

Closing Date—The contest closes March 1, 1947 and awards will be made on March 15, 1947.

Award Committee—The award committee shall be the President, the Chairman of Engineering Committee, and the Chairman of the Publicity Committee of the Industrial Unit Heater Association. This Committee shall be the sole judge as to the merit of articles and the amount of the awards.

WeldELLS *have everything*

WIDEST RANGE
of types; sizes; thicknesses.
SEAMLESS
For greater strength
QUARTER-MARKED ENDS
Easier, more accurate fabrication.
FULL WALL THICKNESS
Never less than specification minimum.
REINFORCED HERE
More metal where the stress is higher.
MACHINE TOOL BEVEL
Best welding surface. Accurate bevel and land.
TANGENTS
Keep weld away from highest stress zone; simplify lining up.
PERMANENT IDENTIFICATION
You can't go wrong on size and weight.

DOWN to the last detail WeldELLS are engineered to meet *all* requirements of *any* pipe welding job. They measure up to *all* requirements of pipe welding more fully than other fittings because they have designed into them features that are combined in no other make.

A number of these features are pointed out above. They give you the means of doing the job as *well* as it can be done —as easily, as rapidly, as economically as it can be done. This combination of features means extra value that is yours only in WeldELLS and other Taylor Forge fittings for pipe welding. Insist on the fittings that *"have everything"* . . . it pays!

TAYLOR FORGE & PIPE WORKS

General Offices & Works: P. O. Box 485, Chicago

Degree-Days for November, 1946

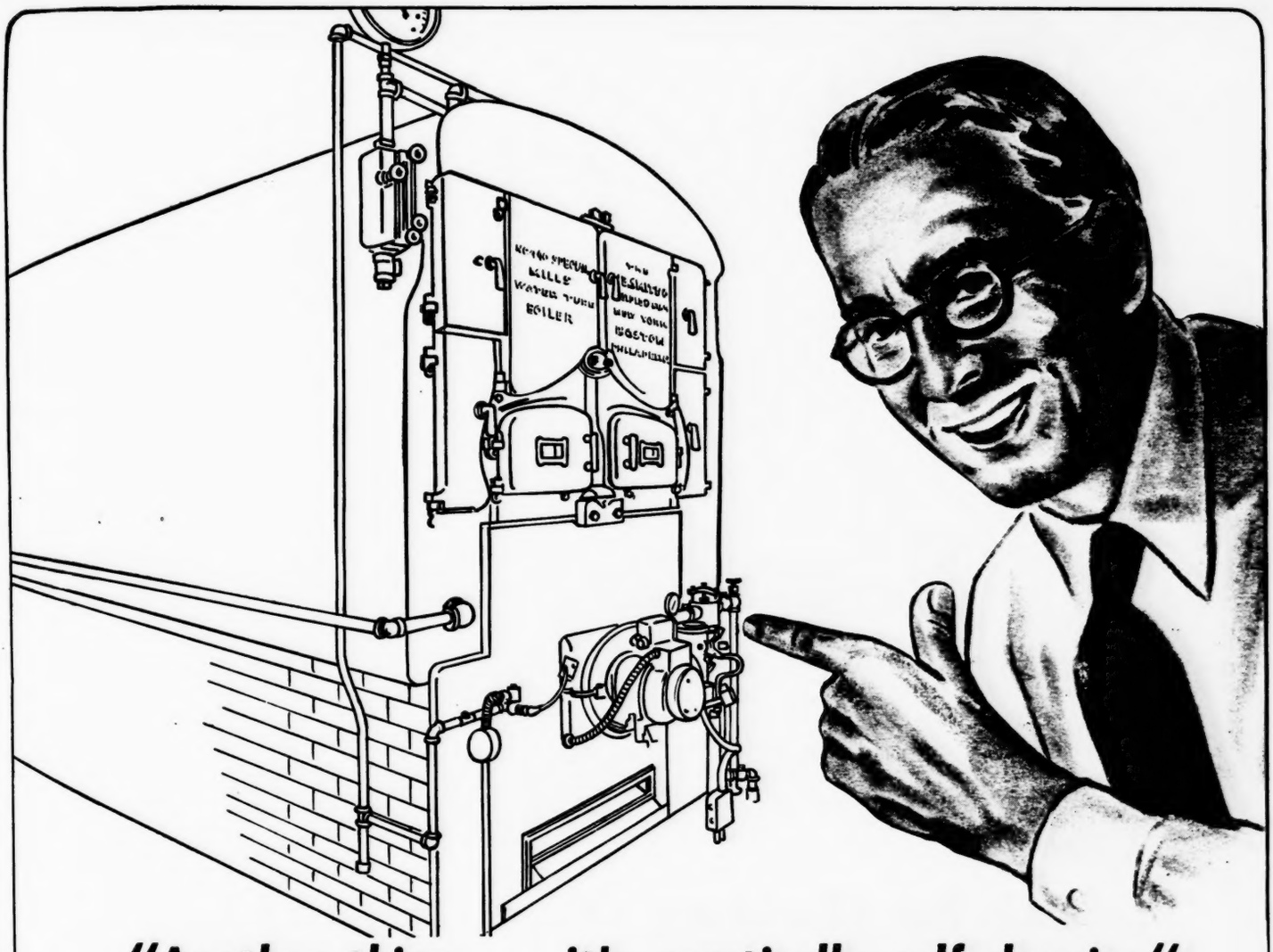
HEATING AND VENTILATING's 20th Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, September 1 to November 30			Heating Season[1]
	1946	1945	Normal	1945-46	1944-45	Normal	Normal
Abilene, Texas	323	262	333	372	389	333	2061
Albany, New York	670	759	774	1106	1372	1292	6580
Albuquerque, New Mexico	704	593	630	989	851	903	4298
Alpena, Michigan	788	826	912	1445	1657	1704	8299*
Anaconda, Montana	1090	1029	951	2367	1922	1933	8357**
Asheville, North Carolina	380	516	576	629	834	852	4232
Atlanta, Georgia	228	361	396	325	494	492	2890
Atlantic City, New Jersey	400	465	588	557	713	842	5176
Augusta, Georgia	150	261	321	212	342	337	2161
Baker, Oregon	906	887	849	1940	1664	1659	7163
Baltimore, Maryland	379	464	567	524	689	790	4533
Billings, Montana	994	908	909	1900	1614	1622	7119
Binghamton, New York	614	706	798	1011	1288	1359	6808
Birmingham, Alabama	225	340	318	330	481	318	2352
Bismarck, North Dakota	1117	1229	1113	2128	2133	1961	9192
Block Island, Rhode Island	456	539	573	716	910	852	5788
Boise, Idaho	819	762	738	1601	1296	1274	5552
Boston, Massachusetts	515	584	693	806	1023	1104	6045
Bozeman, Montana	1067	1037	1006	2181	1922	1993	8521**
Buffalo, New York	614	727	774	995	1268	1322	6822
Burlington, Vermont	759	822	861	1281	1558	1486	7514
Butte, Montana	1119	1078	923	2484	2102	1922	8272
Cairo, Illinois	394	471	519	503	677	677	3909
Canton, New York	791	868	906	1362	1644	1652	8020
Charles City, Iowa	874	942	936	1381	1644	1505	7588
Charleston, South Carolina	102	200	207	122	245	207	1769
Charlotte, North Carolina	257	366	426	374	508	541	3120
Chattanooga, Tennesee	303	411	426	464	609	531	3118
Cheyenne, Wyoming	965	810	900	1903	1658	1745	7466
Chicago, Illinois	678	710	696	910	1175	1098	6077
Cincinnati, Ohio	432	578	615	601	894	869	4684
Cleveland, Ohio	569	626	732	854	1090	1125	6155
Columbia, Missouri	551	591	651	733	941	911	4922
Columbia, South Carolina	170	270	324	235	358	355	2364
Columbus, Ohio	516	623	690	738	1001	1003	5398
Concord, New Hampshire	737	812	846	1315	1532	1498	7353
Concordia, Kansas	680	647	693	1018	1022	969	5315
Dallas, Texas	273	206	303	320	299	303	2256
Davenport, Iowa	688	774	795	962	1285	1158	6289
Dayton, Ohio	570	676	660	834	1131	933	5264
Denver, Colorado	842	721	759	1429	1255	1259	5874
Des Moines, Iowa	741	770	798	1105	1244	1155	6384
Detroit, Michigan	632	699	777	945	1241	644	6490
Devils Lake, North Dakota	1238	1370	1179	2320	2422	2161	9970
Dodge City, Kansas	694	564	672	1057	936	948	5035
Dubuque, Iowa	760	838	846	1339	1434	1291	6790
Duluth, Minnesota	1060	1137	1074	1975	2135	1970	9483
Eastport, Maine	759	792	843	1369	1590	1662	8520**
Elkins, West Virginia	571	673	741	1047	1202	1182	5697
El Paso, Texas	454	310	381	496	422	421	2428
Ely, Nevada	1055	973	(a)	2108	1815	(a)	(a)
Erie, Pennsylvania	524	630	711	808	1094	1125	6273
Escanaba, Michigan	867	928	960	1616	1816	1794	8771*
Evansville, Indiana	503	569	528	722	871	683	4244
Fort Smith, Arkansas	380	372	408	489	532	470	3147
Fort Wayne, Indiana	664	741	726	1013	1307	1073	5925
Fort Worth, Texas	271	204	252	313	292	252	2148
Fresno, California	430	345	315	570	387	334	2334
Galveston, Texas	113	43	60	119	67	60	1016
Grand Junction, Colorado	820	791	747	1359	1161	1116	5548
Grand Rapids, Michigan	654	741	774	990	1353	1250	6535
Green Bay, Wisconsin	851	916	921	1411	1700	1558	7825
Greensboro, North Carolina	365	480	492	551	720	635	3529
Greenville, South Carolina	273	408	450	393	560	596	3380
Harrisburg, Pennsylvania	533	613	660	802	1015	989	5375
Hartford, Connecticut	587	678	705	917	1187	1097	6036
Hatteras, North Carolina	119	216	234	271	141	234	2571
Havre, Montana	1255	1144	1041	2275	1995	1931	8700
Helena, Montana	1127	999	948	2254	1864	1813	7898
Houston, Texas	129	75	114	142	108	114	1157
Huron, South Dakota	1025	1038	1005	1799	1740	1654	8004
Indianapolis, Indiana	530	645	687	722	1015	985	5298
Jackson, Miss.	181	235	(a)	225	332	(a)	(a)
Kansas City, Missouri	555	566	639	751	881	858	4956
Kewanee, Illinois	730	787	781	993	1138	1193	6139
Knoxville, Tennessee	350	433	519	517	656	702	3670
La Crosse, Wisconsin	881	942	909	1451	1717	1467	7322
Lander, Wyoming	1053	1050	726	2108	1897	1656	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Rose, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kenwanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 102]



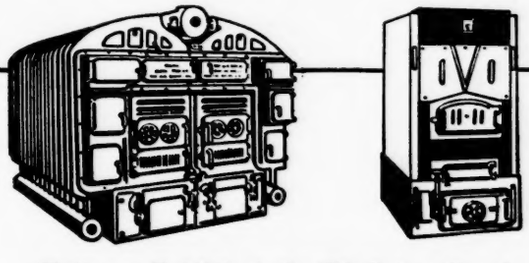
"Another thing . . . it's practically self-cleaning"

Important feature, that! Let Friend Plant Engineer tell you why:

"The vertical water tube construction's the answer. Soot just can't cling to a smooth, vertical surface. Ever notice that dust settles on the *top* — not on the *legs* of a table? Most of the heating surface in H. B. Smith boilers is straight up and down — like the table legs. That's why it accumulates so little soot. When we do want to clean the boiler, those large doors give us easy access to *all* the flues."

Best salesman we have! And he agrees, too, that H. B. Smith boilers last longer . . . resist rust and corrosion . . . are easily installed on new or replacement jobs.

H. B. Smith Cast-Iron Boilers are best for commercial, industrial, institutional, and residential use, with all fuels and fuel-burning methods. You can specify them with confidence, always. Write for your free catalog.



Visit our Exhibit at the 7th International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, Ohio, Jan. 27-31, 1947.

H.B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., WESTFIELD, MASS. Offices and Representatives in Principal Cities

Degree-Days for November, 1946 (Concluded)

HEATING AND VENTILATING'S 20th Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, September 1 to November 30			Heating Season†
	1946	1945	Normal	1945-46	1944-45	Normal	Normal
Lansing, Michigan	701	772	861	1122	1483	1456	7048
Lewiston, Maine	790	853	876	1409	1647	1542	7707
Lincoln, Nebraska	727	696	753	1074	1095	1069	5999
Little Rock, Arkansas	340	358	381	454	515	428	2811
Livingston, Montana	990	901	864	2078	1088	1614	7205
Los Angeles, California	190	138	123	265	167	123	1504
Louisville, Kentucky	428	513	552	587	763	738	4180
Lynchburg, Virginia	380	511	537	608	777	757	3980
Macon, Georgia	160	277	324	262	375	330	2201
Madison, Wisconsin	809	889	891	1247	1572	1437	7429
Marquette, Michigan	901	947	960	1601	1836	1752	8693*
Memphis, Tennessee	305	386	402	416	558	464	2950
Meridian, Mississippi	202	239	312	268	333	334	2160
Milwaukee, Wisconsin	781	793	846	1242	1403	1380	7245
Minneapolis, Minnesota	962	997	963	1590	1730	1537	7850
Modena, Utah	906	819	831	1691	1407	1504	6562
Montgomery, Alabama	142	241	273	180	308	273	1884
Nantucket, Massachusetts	502	529	609	852	910	1007	5957
Nashville, Tennessee	339	455	483	474	679	619	3507
New Haven, Connecticut	537	640	693	847	1091	1092	5895
New Orleans, Louisiana	75	94	102	79	106	102	1024
New York, New York	449	530	594	610	839	916	5274***
†Nome, Alaska	975	1140	1126	1677	1800	1870	14580**
Norfolk, Virginia	238	338	411	309	445	510	3350
North Head, Washington	593	572	510	1272	1265	1131	5452**
North Platte, Nebraska	867	737	837	1455	1250	1313	6366
Oakland, California	408	365	330	693	588	603	3143**
Oklahoma City, Oklahoma	445	355	459	546	530	564	3613
Omaha, Nebraska	755	755	780	1112	1186	1109	6131
Oswego, New York	619	721	783	1017	1310	1356	7088
Parkersburg, West Virginia	463	559	624	665	898	909	4775
Peoria, Illinois	665	766	789	957	1286	1173	6109
Philadelphia, Pennsylvania	406	496	544	543	772	815	4737***
Phoenix, Arizona	271	189	156	295	191	156	1405
Pittsburgh, Pennsylvania	550	588	669	775	990	982	5235
Pocatello, Idaho	888	894	813	1757	1598	1468	6655
Portland, Maine	735	819	807	1317	1590	1446	7218
Portland, Oregon	588	545	558	1093	944	995	4469
Providence, Rhode Island	502	579	693	778	991	1104	6015
Pueblo, Colorado	918	696	741	1421	1187	1135	5514
Raleigh, North Carolina	(a)	359	429	(a)	513	559	3234
Rapid City, South Dakota	938	884	870	1846	1585	1529	7118
Reading, Pennsylvania	488	575	669	702	931	1013	5389
Red Bluff, California	392	418	(a)	553	477	(a)	(a)
Reno, Nevada	809	741	714	1583	1289	1311	5892
Richmond, Virginia	332	423	456	474	619	617	3695
Rochester, New York	637	735	786	1015	1340	1289	6732
Roseburg, Oregon	618	535	561	1193	928	1022	4428
Roswell, New Mexico	542	393	516	674	630	702	3484
Sacramento, California	420	352	351	568	407	422	2653
St. Joseph, Missouri	619	633	633	851	1002	881	5161
St. Louis, Missouri	476	576	597	617	846	802	4585
Salt Lake City, Utah	801	774	723	1517	1292	1129	5555
San Antonio, Texas	180	121	126	203	180	126	1202
San Diego, California	206	160	165	261	173	199	1645
Sandusky, Ohio	548	639	726	796	1068	1079	6208
San Francisco, California	312	268	261	598	501	521	3264**
Sault Ste. Marie, Michigan	937	976	978	1725	1999	1877	9285**
Savannah, Georgia	92	195	201	117	241	201	1490
Scranton, Pennsylvania	583	662	732	917	1179	1189	6129
Seattle, Washington	619	559	570	1196	1043	1150	4934**
Sheridan, Wyoming	1006	958	978	1928	1702	1878	8008
Shreveport, Louisiana	230	231	270	283	312	270	1938
Sioux City, Iowa	925	897	870	1454	1481	1318	6898
Spokane, Washington	914	849	819	1765	1555	1526	6355
Springfield, Illinois	628	668	681	814	1016	963	5373
Springfield, Missouri	550	551	564	747	868	781	4428
Syracuse, New York	614	733	798	1061	1334	1319	6893
Tacoma, Washington	666	590	588	1348	1204	1195	5181**
Terre Haute, Indiana	520	638	615	711	989	848	4872
Toledo, Ohio	647	708	732	975	1252	1110	6077
Topeka, Kansas	596	570	639	829	887	875	4969
Trenton, New Jersey	459	540	588	653	890	830	4933
Utica, New York	649	778	781	1093	1457	1393	6796
Valentine, Nebraska	935	868	897	1675	1505	1480	7039
Walla Walla, Washington	764	643	651	1307	1031	1013	4808
Washington, D. C.	377	485	594	526	741	845	4626
Wichita, Kansas	604	518	636	807	810	828	4673
Williston, North Dakota	1175	1321	1137	2223	2298	2067	9323
Winnemucca, Nevada	850	801	810	1682	1424	1509	6427
Yakima, Washington	910	809	780	1668	1260	1337	5599

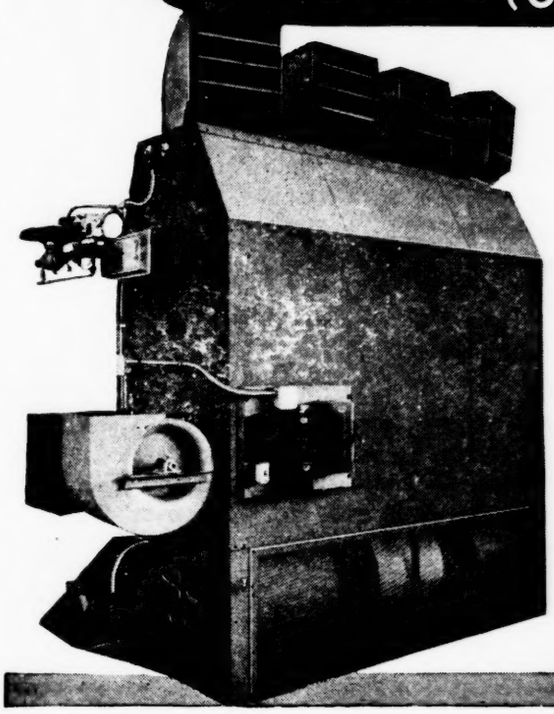
(a) Data not available.
†Nome data are for October.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

†Figures in this column are normal totals for a complete heating season, September to June, incl.

More Efficient Heating With AIRTHERM Direct-Fired Warm Air Heater

(Oil or Gas Fired)



Direct heat transfer through a single thickness of metal results in the high efficiency and low operating cost of the Airtherm Direct-Fired Warm Air Heater. The Airtherm is a self-contained heating system — ready to connect to your fuel and power supply lines.

Capacities from 650,000 to 1,950,000 B.T.U.'s. Either oil or gas-fired.

✓ *Write for Bulletin 801 describing this economical heater in detail.*

See our exhibit Seventh International Heating and Ventilating Exposition, Cleveland, Ohio, January 27-31, 1947.

AIRTHERM

MANUFACTURING COMPANY

AT-43

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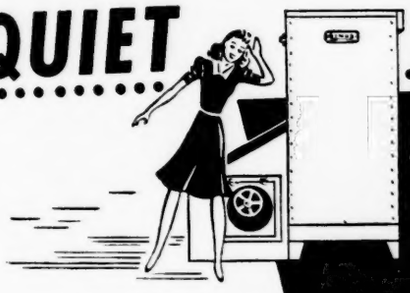
QUIET AS YOUR REFRIGERATOR



BINKS TYPE "B" FORCED DRAFT COOLING TOWERS

Binks Type "B" Forced Draft Cooling Towers are as quiet as a good domestic oil burner or electric refrigerator. A slow speed blower assembly which is practically noiseless takes the place of the conventional high speed propeller type fans. In addition to *extremely quiet performance* Binks Type "B" Tower has a greatly increased air to water ratio with no increase in power consumption. This gives higher efficiency and less wear and tear. Type "B" is primarily recommended for small and medium capacity water cooled refrigeration and air conditioning compressors. However, it is suitable for any other water cooling need up to 60 gals. per minute or 20 tons of refrigeration. Type "B" can be used either indoors or outdoors.

WRITE NOW FOR BULLETIN No. 700

Bulletin No. 700 describes completely Binks Type "B" Forced Draft Cooling Towers. It supplies complete specification data including dimensions and ratings. A typical performance table is included. Drop a postcard in the mail today for your free copy of Bulletin No. 700.

THERE IS A BINKS COOLING TOWER FOR EVERY WATER COOLING NEED

BINKS MANUFACTURING COMPANY • *Offices in all principal cities*

3114-40 CARROLL AVENUE, CHICAGO 12, ILLINOIS

Going Underground?

THEN YOU WILL WANT TO WRITE AT ONCE FOR INFORMATION ON THE NEW SIMPLIFIED MONOLITHIC CONDUIT WHICH ELIMINATES STRUCTURAL JOINTS AND VOIDS, DOES NOT REQUIRE DRAINAGE OR VENTILATION AND PROVIDES A PERMANENT WATERPROOF INSULATION.

UNIVERSAL ZONOLITE INSULATION CO.

135 South LaSalle Street, Chicago 3, Ill.

"Z"crete

Underground Pipe Insulation

ABSTRACTS AND REVIEWS

HEATING AND AIR CONDITIONING

Allen and Walker's well known text book is now in its sixth edition, with considerable revision of text and new material. John W. James, Research Engineer, Iron Fireman Manufacturing Co., has been added as a co-author.

New with this edition are material on reversed cycle refrigeration, a section on panel heating, a revised chapter on fuels and boilers, and data on odor removal apparatus plus air sterilization.

Other important changes are in the chapters on gravity warm air furnace heating and residence air conditioning. The chapter on hot water heating includes information on the design of small forced circulation systems.

The first edition of this text book appeared in 1918, and there have been successive editions in 1922, 1935, 1939.

Heating and Air Conditioning, by Allen, Walker and James. Cloth bound, 6 x 9 in., 667 pages. Published by McGraw-Hill Book Co. Price, $5.50.

RADIANT HEATING

Although radiant (or panel) heating of buildings has been growing rapidly in popularity for years, references to the subject have been almost entirely isolated technical papers, articles or relatively brief publications of manufacturers of pipe and tubing. The subject has grown to a point where a really comprehensive treatise is needed, and this need is met by "Radiant Heating," by T. Napier Adlam, a 472 page book.

Practical in its approach, the book thoroughly covers complete information on design, installation, and control of hot water, steam, warm air, and electric radiant heating systems for buildings. In addition, the related, but relatively new, subjects of snow melting and radiant cooling are discussed in detail.

Mr. Adlam, the author, is recognized both in the United States and abroad as an outstanding authority on radiant heating. He was associated with Mr. A. H. Barker when the latter obtained the first patents on radiant heating in England. Mr. Adlam has had over thirty years' experience with radiant heating in all of its present known phases, including 16 years in the United States. He is a graduate of Swindon Engineering College, England, a member of the American Society of Heating and Ventilating Engineers, the Institution of Heating and Ventilating Engineers, England, the British Institution of Patentees, the Whitworth Society of Scholars, and is a Fellow of the Royal Society of Arts. He is at present vice-president and general manager of Sarco Manufacturing Corporation, New York, makers of various types of controls and other heating equipment.

Intended for engineers, contractors, architects, builders and others concerned with building heating and snow melting for walls, driveways or airports, "Radiant Heating" is primarily a working manual on the

with Tal's Portable, Hydraulic Bender

• Bending pipe on the job is making **more money** for those contractors alert enough to get behind radiant heating with the right equipment—a Tal portable pipe bender. This best engineered machine bends cold to any angle all wrought iron or steel pipe ⅜" to 3" in one single, fast moving operation. It reduces the need for welds by from 40% to 80% — speeds up installation work. Used now by leaders who know it repays its low cost many times a year. Write for bulletin

Tal's Prestal Bender, Inc.

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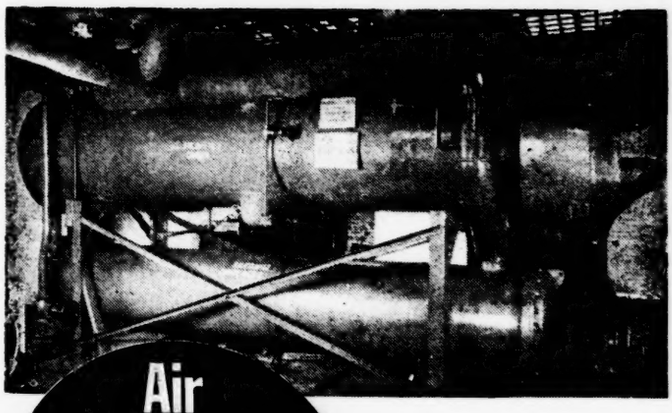

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Reports on the temperature, humidity, and pressure of the air are radioed back to recording instruments on the earth by the Bendix-Friez Radiosonde, carried to heights of 16 miles or more by a balloon. These "weather" reports proved invaluable to the United Nations during the War: thousands of Radiosondes were sent aloft each month.

The Friez Instrument Division of Bendix Aviation Corp. calibrates Radiosondes in its plant at Towson, Md., with the test chamber shown below. This is cooled from + 104 to —100 deg. F. in 75 minutes, the air pressure being simultaneously reduced to match flight conditions. Cooling is accurately controlled by a two-stage Frick Refrigerating System using Freon-22.

The installation was designed and erected by the Paul J. Vincent Company, Frick Distributors at Baltimore.

For the solution of that particular refrigerating, ice-making or air conditioning problem of yours, get in touch with the nearest Frick Branch or Distributor.

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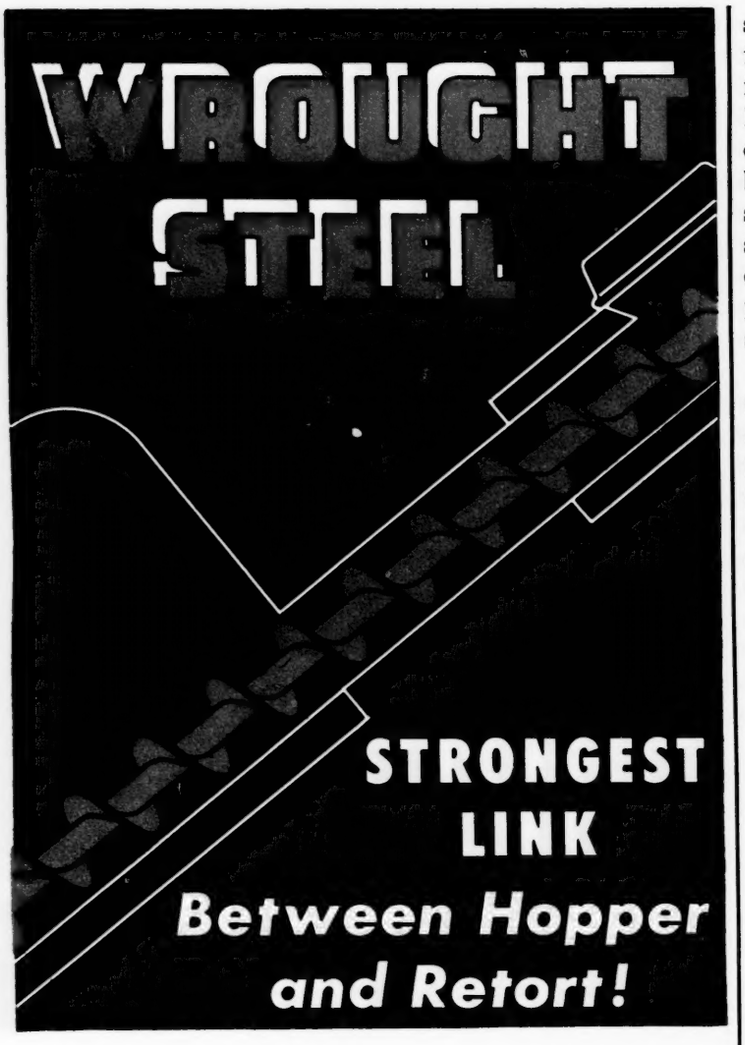

The Crown Stoker Feed Screw

Rugged dependability that lasts—year after year an unbreakable link between hopper and retort. That's the Crown *wrought steel* stoker feed screw. This tough, wrought steel screw, continuously welded, possesses a definite grain structure, grain that accents strength where it is most needed, grain that resists the wear of constant use. Then, too, you'll find far less coal degradation using smoother surfaced wrought steel. If you want top equipment for your stoker, you'll find the Crown wrought steel stoker feed screw ideal.

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subjects. Included among the 309 illustrations are 64 full-page charts for determining pipe size and spacing for as many types of floor and ceiling construction. Data resulting from the author's own tests on effect of floor coverings are also included. Formulas have been reduced to the simplest terms consistent with sufficient accuracy to meet practical requirements, and simple easy-to-use charts give most of the essential design data without calculation. Exact step-by-step procedure in designing and installing radiant heating systems is summarized.

Chapters include those on theory of heat radiation, artificial heating as related to bodily heat losses, measurement of comfort, determining mean radiant temperature, temperature studies in radiant heated rooms, radiant heating with ceiling panels, radiant heating with floor panels, use of wall panels, metal panels, and electricity, air venting and flow adjusting, controls for radiant heating, areas and surface temperatures of radiant heat panels, determining panel pipe size, spacing and heat input, radiant cooling and air conditioning, snow melting by embedded pipes, and step-by-step procedure in radiant heating design.

Radiant Heating, by T. Napier Adlam. Cloth bound, 6 x 9 in., 472 pages. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price, $6.

ACRMA EQUIPMENT STANDARDS

Standards published in July, 1941 by the Air Conditioning & Refrigerating Machinery Association, and standards that they have published since that date, are now released in the 1946 edition of Equipment Standards. The association points out that these standards are not to be considered as mandatory practice but as helpful guides to manufacturers and purchasers of air conditioning and refrigerating machinery.

The material is divided into five parts as follows: room air conditioners and self contained air conditioners; compressors and condensing units; condensers and receivers; water and brine coolers; and miscellaneous standards. In the last group are data on ammonia mains, Freon-12 mains, and steel and wrought iron pipe.

Equipment Standards 1946 Edition. Spiral bound with heavy paper cover, 8½ x 11 in. Published by Air Conditioning & Refrigerating Machinery Association, Inc., Price, $2.

ELEMENTARY HEAT POWER

To develop an understanding of heat-power machinery for the engineering student, Solberg, Cromer and Spalding of the Mechanical Engineering Department of Purdue University, have written Elementary Heat Power. It is intended to provide a balanced course for those without engineering thermodynamics, and as a background for the testing of heat-power equipment.

Starting in with the basic concepts of matter and energy, the reader is taken through the various types of internal combustion engines, steam power plant cycles, steam engines and steam turbines, pumps, gas turbine power plant and mechanical refrigeration.

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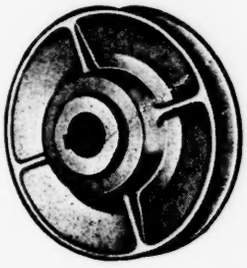

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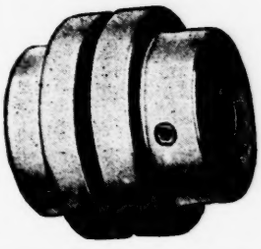

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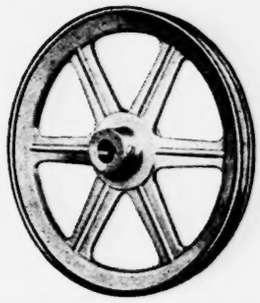

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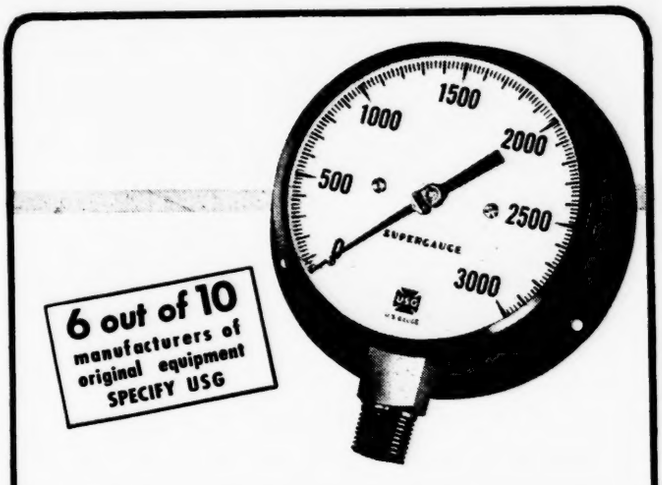

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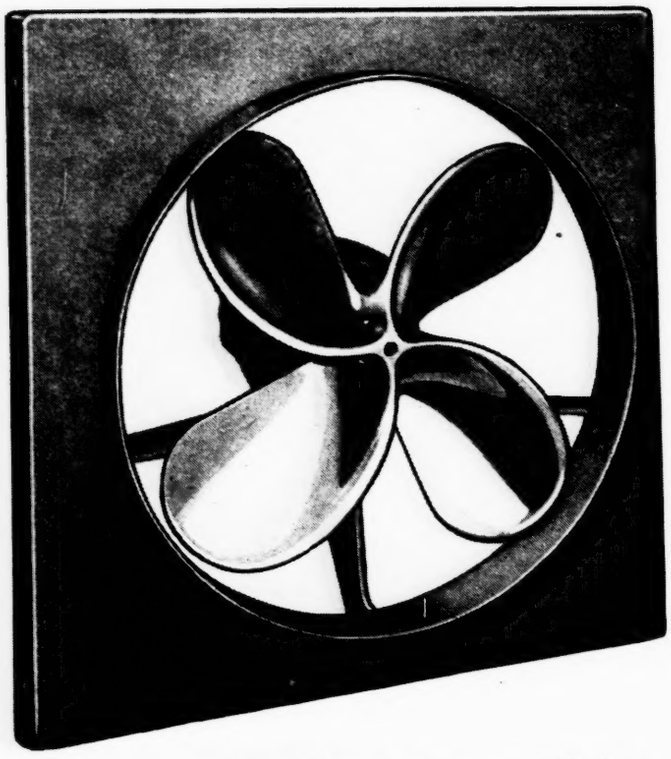

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This book is recommended for those who want a good basic knowledge of the subject or as the fundamental basis to be followed by further study on special phases of the wide field of heat power.

Elementary Heat Power, by Harry L. Solberg, Orville C. Cromer, and Albert R. Spalding. Cloth bound, 5¼ x 8¼ in., 480 pages. Published by John Wiley & Sons, Inc. Price, $4.75.

TRADE-MARK LAW

In preparation for the new Lanham Act which becomes law in July, the Research Institute of America has issued Preparing for the New Trade-Mark Law. It points out what one must do where a trade mark has been registered under the Acts of 1905 or 1881. The institute recommends that marks denied registration under the present law be reexamined to see if the copy will qualify under the new law.

The report covers the ownership and use of trademarks, qualifying a trade-mark for registration, trademarks in foreign trade, and steps to be taken before the law goes into effect in July, 1947.

Preparing for the New Trade-Mark Law. Paper bound, 8¼ x 10 in., 56 pages. Published by Research Institute of America. Price, 80 cents.

● ● ●

CAST IRON RADIATORS—A revised set of simplified practice recommendations (R174-47) for cast iron radiators has been issued by the National Bureau of Standards. These standards became effective January 1, 1947, and are the result of work carried on with the Institute of Boiler & Radiator Manufacturers. Copies at 5c each can be obtained by writing the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

SMOKELESS OPERATION—A four-page folder, "Factors Affecting Smokeless Operation of Underfeed Stokers" has been issued by the Stoker Manufacturers' Association. Material has been prepared and published for the guidance of stoker distributors, installers and others interested in smoke abatement. Single copies, 5c, available from the association, 307 North Michigan Ave., Chicago 1, Ill.

AS THE BRITISH SEE US — An interesting report, "Domestic Heating in America," has been published by H. M. Stationery Office. It is the result of a study of heating in the United State and Canada by a party from the Ministry of Fuel and Power and the Building Research Station and Fuel Research Station of the Department of Scientific and Industrial Research. The investigation revealed that American methods of heating would make it possible to provide heat for an English house for about the same amount of fuel used in open fireplaces. The report covers climatic condi-

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Bulletin 744

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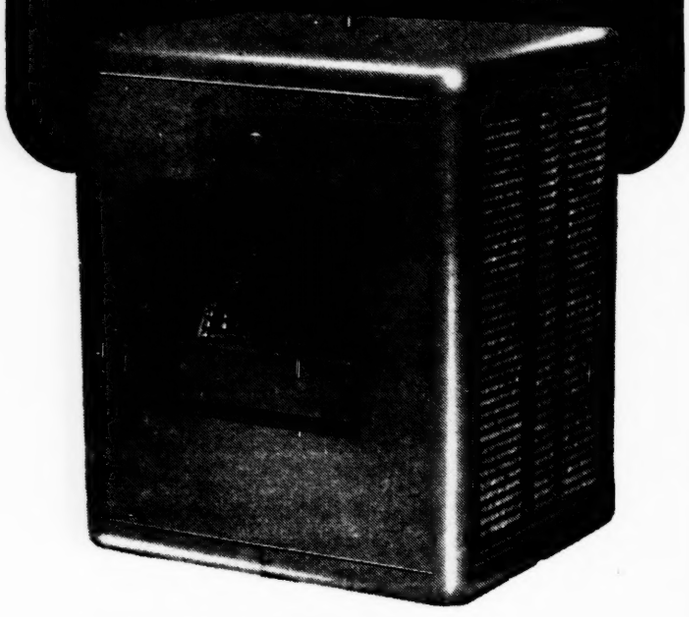

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tions, fuel resources and costs, heat demand, distribution sale and maintenance of appliances, the relationship of heating to house planning, smoke abatement, chimneys, heat insulation, research work and consumer reaction. In arriving at the findings contained in this report, the party made a three-month coast to coast tour and met a large number of architects, heating engineers, research workers, public utility officials, appliance manufacturers and housing managers. Copies at 3s 4d may be obtained from H. M. Stationery Office, London.

ELECTRIC CODE REVISIONS.—It has been the practice of the National Electrical Manufacturers Association, since 1931, to publish an analysis of the changes in new editions of the National Electrical Code. Changes which are purely editorial are not generally mentioned, but where there is a change in substance, such a deviation is noted. The 1946 edition of the code contains a number of changes from the previous one. This 143-page paper bound book should prove of value to those who make frequent use of the National Electric Code. Price, 50 cents—less in quantities of 10 or more copies.—*National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y.*

BODY DESIGN FOR MOTOR TRANSPORT—Presented as a paper before the annual meeting of the American Society of Refrigerating Engineers in New York City, S. C. Hunt, Sales Engineer, Fruehauf Trailer Co., described the insulated body design of motor transport refrigeration. Between the outside paneling and supporting structure, there is a combination waterproof paper, zinc chromate primer and mastic sealer to limit the transfer of moisture. It also reduce convection and conduction to the outside. Fiberglas is used as insulation and is tightly fitted in vertical strips between the framing of the unit. Truck bodies and refrigeration apparatus must be designed for weight reduction and for thermal efficiency. He recommended that the efficiency of the refrigeration device be expressed in terms of Btu output per pound of weight to call attention to the importance of weight in this field.

TESTING BOILER WATER—Three suitable methods for applying the calorimetric phosphate test to boiler waters containing tannin are described in an 11-page report by L. Goldman and R. N. Love with the Boiler. Water Service Section, Department of the Interior, College Park, Md. Tannin in boiler water causes difficulties in analytical testing because its colloidal action interferes with the removal of suspended matter by filtration and because some color is imparted to the water. The three methods used by the Bureau are: Potassium nitrate coagulation, potassium persulfate bleach, and tannin removal by decolorizing carbon. The last method is considered the quickest and most convenient. For a free copy of the report, Report of Investigation 3983, Calorimetric Phosphate Tests for Boiler Waters Containing Tanning, write to the Bureau of Mines, Department of the Interior, Washington 25, D. C.

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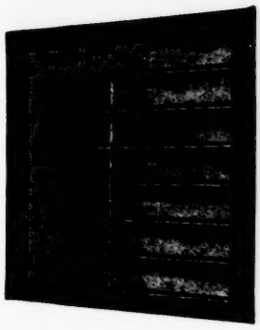

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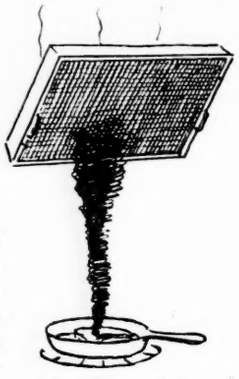
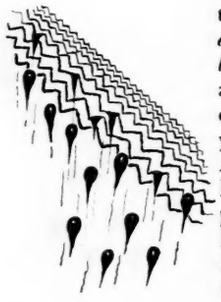


How it works: The Greastop, one of many Air-Maze filters, is made up of wire meshes, which act as baffles to remove grease droplets suspended in the air stream. It offers minimum resistance to the passage of air.

Have you a filtering problem? Maybe kitchen ventilation isn't it. But whether you manufacture or use engines, compressors, air conditioning and ventilating equipment, *or any device using air or liquids* — the chances are there is an Air-Maze engineered filter to serve you better. Call your Air-Maze distributor, listed in the yellow pages of your phone book. Or write to Air-Maze Corp., Cleveland 5, Ohio.



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NEW CATALOGS

Thermal Properties of Plexiglas

An 11-page technical bulletin giving the engineer and designer a quick and accurate method of determining heat losses through Plexiglas, thickness of Plexiglas necessary to effect a desired insulation, and other technical information necessary for the intelligent design of Plexiglas objects. This information was compiled by the Rohm & Haas Physics Laboratory. Includes an alignment chart for air-to-air heat transmission through Plexiglas.—*Rohm & Haas Co., Philadelphia 5, Pa.* **172**

Thermocouples

A 36-page catalog of thermocouples, protection tubes, wire, and accessories, gives performance data, diagrams, and specifications for the Alnor line of thermocouples and accessories.—*Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.* **173**

Piping

"Pipe in American Life," a 48-page, illustrated booklet, presents the historical background and modern uses of metal pipe with emphasis on the use of steel pipe. Chapters covering uses of steel pipe in homes, large buildings, process industries, railroads, etc. are presented.—*American Iron and Steel Institute, 350 Fifth Ave., New York 1, N. Y.* **174**

Industrial Exhausters

Bulletin 3576, is a 32-page bulletin describing the new Buffalo industrial exhausters. This heavy-duty, steel plate fan, has completely welded housing, is adjustable and reversible. Three rotors are available, one for air handling, two for material handling. Ratings for all models are given.—*Buffalo Forge Co., P. O. Box 985, Buffalo 5, New York.* **175**

Panel Heating Manual

A manual on the control of radiant panel heating entitled "Automatic Control of Radiant Panel Heating," has been prepared with the assistance of F. W. Hutchinson and contains diagrams, charts and photographs for determining required performance of heating installations under control. — *Minneapolis-Honeywell Regulator Co., 2701 Fourth Ave., South, Minneapolis 8, Minn.* **176**

Oil Burners

A 12-page bulletin describes the York-Heat horizontal rotary oil burner, featuring simple flame adjustment, precision air-oil control, pressure type igniter. A flame former is said to be able to shape the flame in accordance with boiler dimensions.—*York-Shipley, Inc., York, Pa.* **177**

Air Operated Controllers

Bulletin DM-15 describes the Bristol Model 93 air-operated controllers for temperature ranges between —125F and 1000F. This model is used where variables must be controlled but not necessarily recorded. It may be used to control temperature, pressure, liquid level, humidity, and fluid flow. — *The Bristol Company, Waterbury 91, Conn.* **178**

Water Chillers

A 12-page catalog features a new line of Dry-Ex water chillers, including specifications, heat transfer data, instructions for selection, size diagrams, etc.— *Acme Industries, Inc., Jackson, Mich.* **179**

Exhaust Fans

Exhaust fans for business and industry are illustrated and described in a new 16-page catalog which includes data on fan sizing and types with methods of installation.—*The Emerson Electric Mfg. Co., 1847 Washington Ave., St. Louis 3, Mo.* **180**

Welding and Cutting

A new 64-page general welding and cutting products catalog is divided into two sections, one for oxyacetylene welding and cutting supplies, and the other for arc welding machines, accessories and electrodes.— *Air Reduction Sales Co., 60 E. 42nd St., New York 17, New York.* **181**

Water Conditioning

Water conditioning chemicals and equipment with analysis instructions and price lists are presented in an instruction booklet prepared for power plant operators covering test procedures in conditioning boiler feed water.—*Allis-Chalmers Mfg. Co., Milwaukee.* **182**

Gauges and Thermometers

A line of pressure, vacuum, altitude, hydraulic, ammonia, and compound gauges and remote reading dial thermometers are presented in a three-color, 19-page booklet.—*Jas. P. Marsh Corp., 2073 Southport Ave., Chicago 14, Ill.* **183**

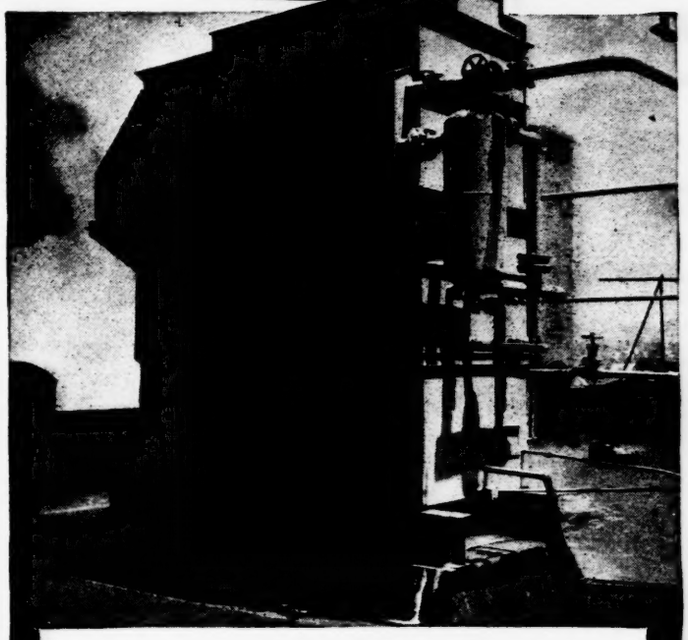
Refrigeration Equipment

A line of refrigerating coils, unit coolers, blowers, and defrosting units is described in an 18-page catalog with ratings, sizes, specifications and diagrams.—*Bush Mfg. Co., Hartford 6, Conn.* **184**

Standardized Drives

Data Book No. 110, a 12-page presentation of information on Central drives. Contains several comprehensive engineerin tables on V-belt drives for various speed ratios and pulley diameters.—*Central Die Casting and Mfg. Co., 2935 W. 47th St., Chicago.* **185**

POWER SAVING FOR REFRIGERATION USERS



The NIAGARA *AERO-PASS CONDENSER saves power by permitting you to operate your compressors at the lowest head pressure that will distribute your refrigerant properly. Reducing the differential between head pressure and suction pressure makes less work for your motors and cuts your demand load.

In addition, since the NIAGARA AERO-PASS CONDENSER uses only the water it evaporates to absorb the heat in condensation, it saves expense in water and pumping. Your refrigeration plant will both gain in capacity and operate at lower cost. NIAGARA Condensers are designed and built for years of dependable service.

Ask for Bulletin No. 91- HV.

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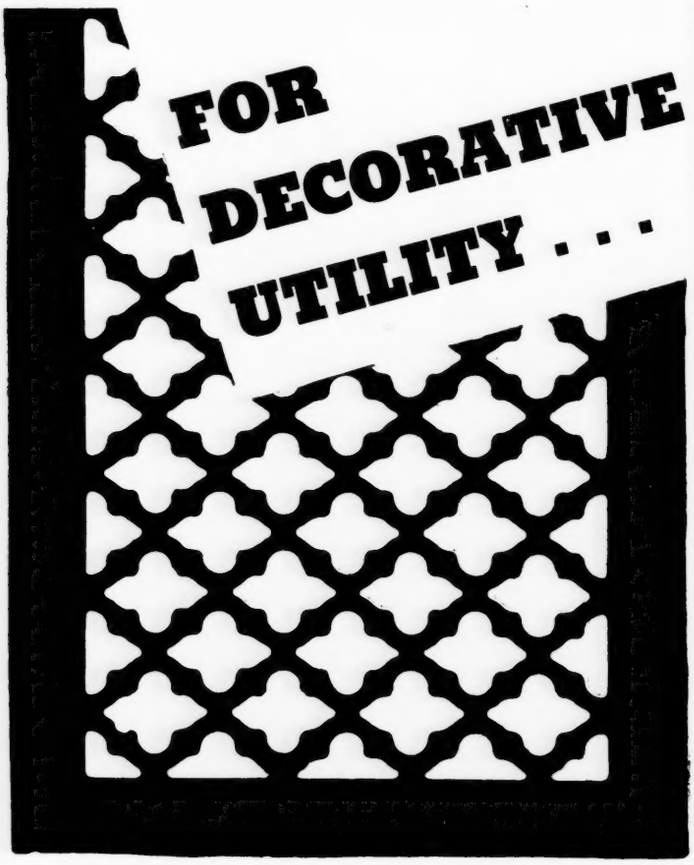
Field Engineering Offices in Principal Cities

NIAGARA

***AERO-PASS CONDENSER**

Trade-mark Registered for the Niagara Condenser with the patented Duo-Pass, Oilout and Balanced Wet Bulb Control



select one of the hundred distinctive designs of Hendrick Grilles

Hendrick Grilles, made of heavy-gauge, commercially rolled metals, are available in a wide choice of attractive designs with ample open areas. Perforations are clean-cut, and there are no burrs or other imperfections.

Hendrick Grilles are easy to install, and always lie flat because of a special flattening operation in their manufacture.

The grille illustrated is the Gothic Clover Leaf. Write for detailed information.

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"Shur-Site" Treads and
Armorgrids

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Control Valves

Pneumatic control valves and control accessories are described in Bulletin 277-1, 36 pages. A page in full color shows identifying enamel finishes corresponding with the A.S.A. color code. Tables show specifications for control valves and needle valves. An appendix contains information on computing valve sizes.—*The Foxboro Company, Foxboro, Mass.* 186

Flareless Coupling

A 4-page bulletin describes the Ferulok flareless coupling for heavy wall tubing. This coupling features a 3-part assembly which requires no special tools or brazing. The bulletin gives engineering data and ordering instructions.—*The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.* 187

Steam Generators

A 12-page bulletin contains information on the Springfield line of boiler installations, ranging in sizes from 6 to 17,000 lb per hr.—*Springfield Boiler Co., 1945 E. Capitol Ave., Springfield, Ill.* 188

Stokers

Heavy duty, ram type, underfeed stokers described in a 12-page bulletin featuring cutaway drawings, control diagrams, and installation data.—*Canton Stoker Corp., Andrew Pl., S.W., Canton, Ohio.* 189

Two Stage Pumps

Bulletin C746 deals with the ball bearing type DMD, two-stage pump, featuring an opposed impeller design permitting the use of a short shaft which promotes rigidity. DMD units are made in capacities from 75 to 700 GPM for heads from 175 to 400 feet at 1750 RPM.—*Economy Pumps, Inc., Hamilton, Ohio.* 190

JANUARY, 1947

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, circle on the list below the publications wanted, using the item number at the end of each review.

Print your name and address, mail to
Editor, HEATING AND VENTILATING,
148 Lafayette Street, New York 13, N. Y.

172	173	174	175	176	177	178
179	180	181	182	183	184	185
186	187	188	189	190		

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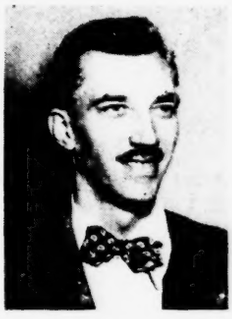
Getting Personal

Eugene B. Delgass *(Effect of Catalytically Cracked Fuels on Heating System Design,* page 61) received his B.S. in Chemical Engineering from New York University in 1935. He has been employed by Socony-Vacuum Oil Co., Inc., since 1936, in refinery engineering service. During the war he was assigned to the Aviation Gasoline Advisory Committee of the Petroleum Industry War Council. At present he is supervisor of Product Engineering Division, Technical

B. S. Garrett



E. S. Delgass

Service Laboratories, Brooklyn, N. Y., part of Socony-Vacuum.

Bowman S. Garrett, co-author, received his M. S. degree in Chemistry from Louisiana State University in 1942. Since August, 1945, he has been employed by Socony-Vacuum Oil Co., Inc., as staff engineer in the Product Engineering Division, Technical Service Laboratories, Brooklyn, N. Y.

A. F. Lukens *(Selection of Medium Size Motors,* page 69), holds both BS in Engineering and EE degrees from Princeton University.

He spent one year with the General Electric on test work and then in 1928 entered the single phase motor department for that company at Pittsfield, Mass. In 1932 he was transferred to Lynn and worked on the development and design of single phase motors.

From 1938 until 1941 he spent most of his time in the application of small integral motors with special emphasis on refrigeration and air conditioning.

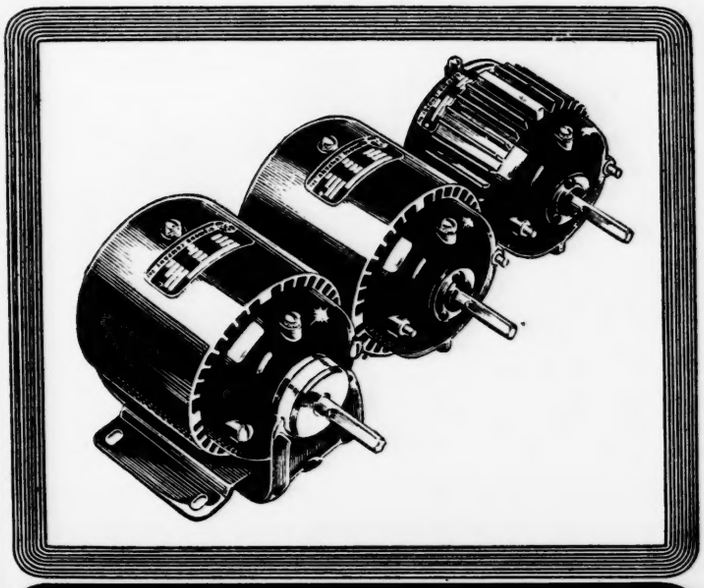
During the war years he handled the application of motors for the Navy. In 1945 he transferred to the Industrial Engineering Division as application engineer in the Lynn Motor Section.

H. G. Barott

Herbert G. Barott *(Data for Proper Design of Poultry Houses Result from Government Research,* page 77) received his E. E. degree from Syracuse University in 1909. From 1910 to 1917 he served as assistant physicist, Bureau of Standards, where he was concerned with temperature and heat measurements.

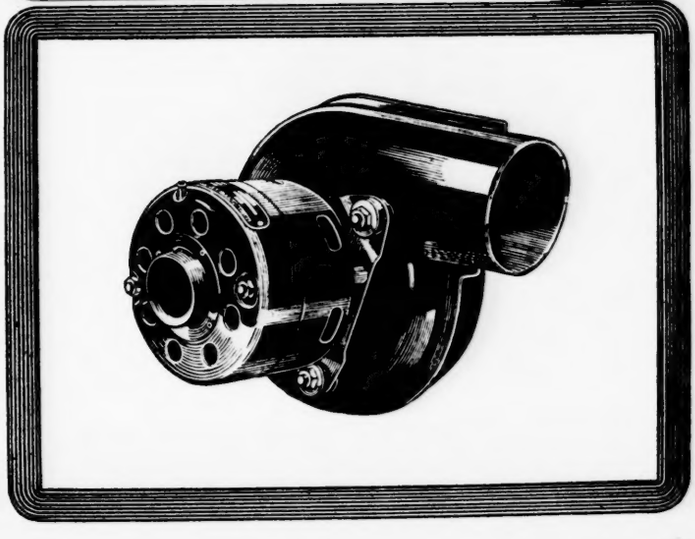
From 1917 to the present he has been physicist with the Department of Agriculture, and director of research with the respiration calorimeter.

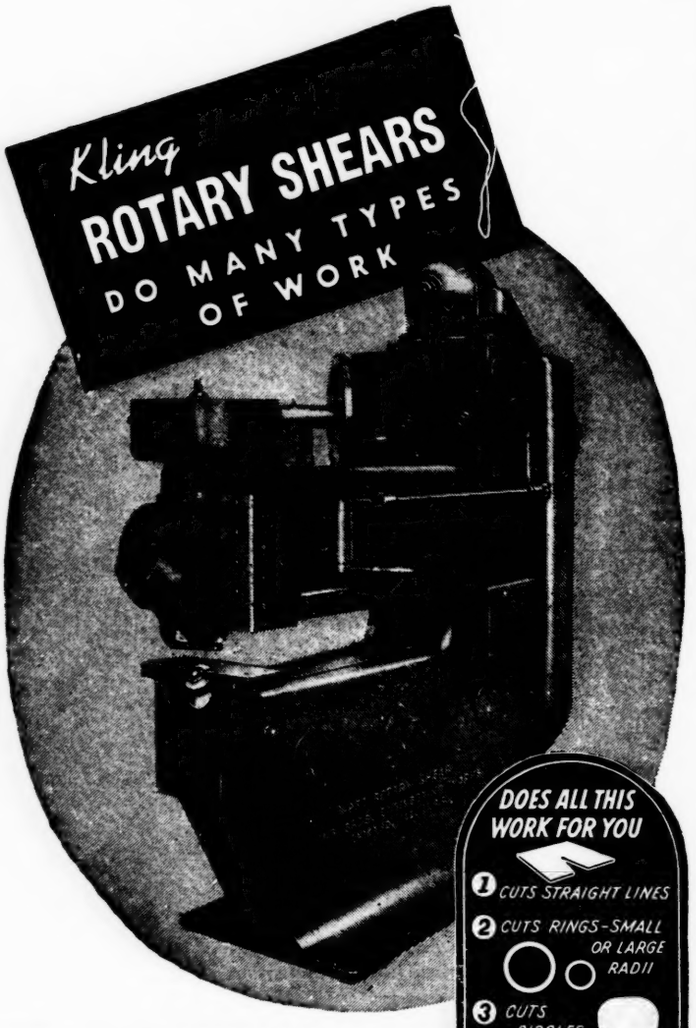
During his years with the Department of Agriculture he has been engaged in interesting research projects. During 1917-1924 he investigated energy and gaseous metabolism of humans at rest and at work. For the next ten years he



Redmond

REDMOND





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which will give you specific facts, and specifications. No obligation involved. Users of heavy equipment of Kling Rotary Shears' class will receive a copy of this Bulletin promptly, on request.

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studied the growth, mortality, hatchability and the energy and gaseous metabolism of the developing chick-embryo. From 1934-1942 he investigated the effect of the physical factors of environment on the heat production and gaseous metabolism of the chicken from the time of hatch to maturity.

Aside from all this, he is particularly fond of trout fishing and hunting for deer in the Adirondacks, and outdoor life in general. Mr. Barott is an ardent devotee of golf and bowling. His other interests are stamp collecting, chess, contract bridge and poker.

. . . Since the Last Issue

Dravo Corp., of Pittsburgh, Penna., has opened a new sales office at 305 Techwood Drive, N. W., Atlanta, Ga. **Robert A. Hedges** has been transferred to the southern city to manager the office, and will actively represent Dravo Corporation in the sale of Dravo Counterflo oil and gas burning direct fired heaters and Dravo crane cab coolers. Mr. Hedges will handle sales, through local distributors in Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee and parts of Arkansas and Virginia. There are eleven Dravo distributors in the area now. Mr. Hedges plans to appoint more in the near future.

R. A. Hedges

The **Bryant Heater Co.** has established a graduate fellowship in gaseous fuels at **Case School of Applied Science.** The fellowship, which is open to graduates in Mechanical Engineering, carries a stipend of $1,850 of which $500 is in the form of tuition. The holder of the fellowship will be employed by the Bryant Heater Co. during the summer preceding the term in which he begins his studies.

Leonard K. Wright, Jr., of Knoxvile, Tenn., representing **Alco Valve Co.** in southern territory, is transferred as of January 1 to Columbus, Ohio, succeeding Hugo C. Smith, of Cleveland. The Ohio territory also includes western Pennsylvania and West Virginia, and eastern Michigan. Mr. Wright's former territory in the southern states was taken over on the same date by **William B. Knox**, of Atlanta, Ga.

Organization of **Toledo Heater Co.**, an Ohio corporation, to manufacture automatic oil-fired water heaters, principally for domestic purposes, is announced by **W. T. Ramsay**

W. T. Ramsay

D. S. Woods

and **Donald S. Woods.** Mr. Ramsay is president and general manager; Mr. Woods is executive vice-president and sales manager. The company has completed construction of a new plant located at 25 So. St. Clair St., in Toledo.

Appointment of **L. H. Moulton** to the post of national sales director and **D. T. Buist**, assistant national sales director, was announced recently by **Turco Products, Inc.** Their headquarters will be the firm's main offices in Los Angeles.

A graduate of Colorado College of Agriculture, Mr. Moulton joined Turco in 1931. For the past eight years

L. H. Moulton

D. T. Buist

he has directed Turco's Eastern Division from the Chicago plant office.

Dan Buist joined Turco in 1936 as a specialist with 20 years' experience in the automotive field. Transferred to the aviation division in 1939, he was promoted to district sales manager in 1943, and western zone sales manager in 1944.

The **Wheatland Steel Products Co.**, Wheatland, Penna., has entered the domestic engineering manufacturing field with the appearance of a standard line of precision couplings for the plumbing supply trade. The company has produced couplings exclusively for the manufacturers' market since May, 1942 and has embarked on the Fabrication of high precision couplings for the dealer field following the completion of an extensive plane expansion program to handle the new product. The steel company is headed by **Edward F. Maneely.** In charge of plant production are **Edward J. Kavanagh** and **T. James Kavanagh**, both long associated with the industry.

Alfred E. Stacey, Jr., one of the seven founders of **Carrier Corp.**, has rejoined that organization as of December 1st. Mr. Stacey, who has been on active duty in the United States Navy with the rank of captain, will be process consultant to the sales division. A graduate of Syracuse University in 1906 with an M.E. degree, Mr. Stacey has been active in the design, development and application of air conditioning and refrigeration equipment throughout his entire carrier. He became associated with Dr. Willis H. Carrier at the Buffalo Forge Co. upon graduation. When the Carrier Air Conditioning Co. of America was organized in 1908, Mr. Stacey became chief engineer. In 1915, he was one of the seven founders of the Carrier Engineering Corp. After five years as Western manager, he became chief research engineer, which position he occupied from 1919 to 1930. When Carrier Corporation was formed in 1930, he became vice-president in charge of engineering. In addition to inventions which resulted in the issuance of thirty-five patents to Mr. Stacey, he designed many industrial and comfort air conditioning installations including that in the United States Capitol. In 1935, Mr. Stacey left Carrier to organize the firm of Buensod-Stacey, Inc., which engineered many important air conditioning installations in the New York metropolitan area, including various buildings in Rockefeller Center. Mr. Stacey's active duty in the Navy began in November, 1940, when he was assigned to the Bureau of Ships.

A. E. Stacey, Jr.

Balancing condensing pressure, water flow and motor load for most economical air conditioning operation is a problem you can solve more readily with the installation of the A-P Model 68-B Water Regulating Valve. With an operating head pressure range of 50 to 150 p.s.i., and easily accessible adjustment of water flow, Model 68-B can be depended upon to maintain the ideal water-flow-condensing-pressure relationship that means so much to uniformly low operating costs.

Exclusive Self-Cleaning Feature Stops "Dirt-and-Lime Troubles"

Differing radically from conventional valve design, Model 68-B Water Regulating Valve employs a molded composition seal on the valve stem. This seal moves across the polished mirror-smooth stainless steel seat with a "wiping" self-cleaning action that avoids common troubles due to dirt and lime in the water. Laboratory tested in sandy water, this sliding seal and seat showed no sign of wear after the equivalent of many years actual field use — indicating a "life-time" of water regulating service.

Write today for complete details on the A-P Model 68-B Water Regulating Valve — and other A-P DEPENDABLE Refrigeration Valves: Thermostatic Expansion Valves, Refrigerant and Water Solenoid Valves, Suction Pressure Regulating Valves, "Trap-Dri" and "Trap-It" System-Protectors, and Cooling Thermostats.

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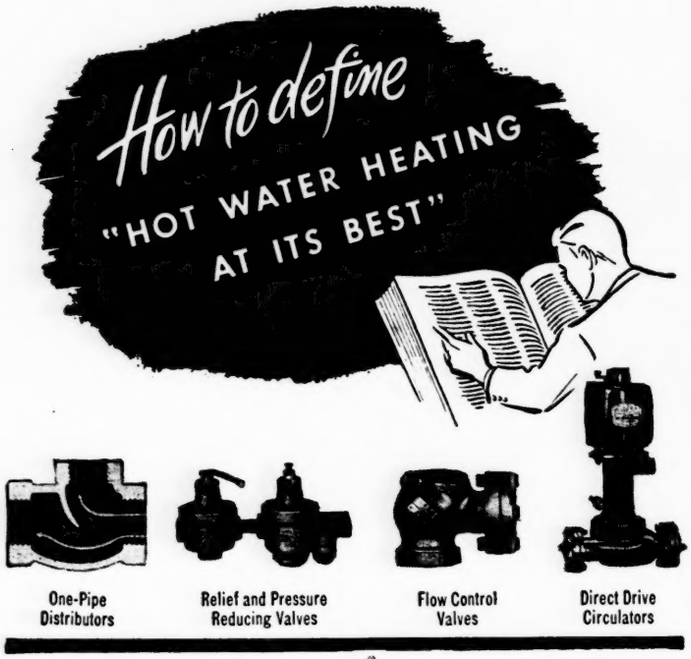

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SUMP PUMPS

Triplex Sump Pumps—designed and built for long, trouble-free service—are always in demand. Float ball, movable between two collars on the float rod, permits wide variation in sump depth. Specially tailored motor, with built in float switch, operates centrifugal closed impeller type pump automatically—with minimum power requirements. Available in iron and steel or brass models. Write for catalog and price sheet.

Triplex
HEATING SPECIALTY CO., INC.
PERU, INDIANA

In addition to units illustrated, the Triplex line includes—Direct Drive Horizontal Circulators, Indirect Drive Circulators, Expansion Tanks, Air Eliminators, Water Mixing Valves, Air Vent Valves, Indirect Heaters, Tankless Heaters, Control Units. Electrical Controls, and Barometric Draft Dampers.

SEE YOUR WHOLESALER TODAY

Frederick R. Lack, vice-president of Western Electric Co. will be president of the **American Standards Association** for the ensuing year. Mr. Lack succeeds **Henry B. Bryans**, executive vice-president of the Philadelphia Electric Co. Mr. Lack formerly was vice-president of the ASA. **George H. Taber, Jr.** will be vice-president of the association for the coming year. He is executive vice-president of the Sinclair Refining Co. and already was a member of the board of directors of the ASA.

The appointment of **James N. Crawford** and **William R. Teller** as vice-presidents of **Bryant Heater Co.** is announced. Both Mr. Crawford, formerly sales manager, and Mr. Teller, heretofore director of engineering and development, will continue work in their respective fields. Mr. Crawford is a native of Cleveland and a graduate of Case School of Applied Science, which granted him a Bachelor of Science degree in mechanical engineering. A member of the staff of the American Gas Association's Testing Laboratory following his graduation from Case, Mr. Crawford became

J. N. Crawford

W. R. Teller

associated with the Bryant Heater Company in 1933 and is well-known in the gas heating sales field. Mr. Teller, who has directed Bryant's research and development since 1944, was previously associated with the Cleveland testing laboratories of the American Gas Association as assistant director. He was graduated from Case School of Applied Science in 1927 with the degree of Bachelor of Science in mechanical engineering and spent the following three years gaining field experience in gas and oil production in western Kentucky.

Appointment of new district managers in Distributor-Dealer Sales Division of **Carrier Corp.** have been announced. **George T. Long** has been made Chicago district manager; **D. B. Arnold**, Cleveland district manager; **G. E. Robertson, Atlanta** district manager and **W. F. Peine**, Dallas district manager. The assignment of **John E. Field** as Eastern zone manager for refrigeration, **John Manion** as Western zone manager for refrigeration and **Frank E. Purcell** as Western zone manager for merchandising equipment has also been announced. Appointment of new district managers in the Direct Sales Division are as follows: **W. S. Bodinus** has been made Chicago district manager; **J. H. Bailey, Cleveland** district manager and **W. H. Steitler**, Dallas district manager. The assignment of **Walter F. Jones** as centrifugal gas compressor specialist of the corporation has also been announced. Mr. Jones will make his headquarters in New York City.

Hendrick Mfg. Co., Carbondale, Pa., perforated and fabricated metal producer, has appointed threee new sales representatives. **A. H. Patten**, head of Patten Engineering Co., Denver, will cover Colorado, Utah, Wyoming, Montana and southern Idaho; **Fred G. Greaves Co.** of Seattle will handle Washington, Oregon and northern Idaho; and, **Orville B. Ackerly, Jr.**, San Francisco, is the new Hendrick representative in northern California and the Reno section of Nevada.

The appointment of **James E. Baker** as advertising manager, Coal Heating Service Division, **National Coal Association** became effective December 15. **Mr. Baker** comes to Coal Heating Service Division from the post of assistant editor, Coal-Heat Magazine, having joined that publication in 1937 following his graduation from the Medill School of Journalism of Northwestern University. Mr. Baker enlisted in the Air Corps in July 1942, and was called to active duty in January 1943. He served in the Pacific area until May, 1946.

J. E. Baker

The **Equipment Sales Co.**, 1107 American Bldg., Richmond, Va. has been appointed to represent the **Research Products Corp.** of Madison, Wis. in the sale of Research air filters in Virginia, North Carolina and South Carolina, and eight northeast counties of Tennessee, it has been announced.

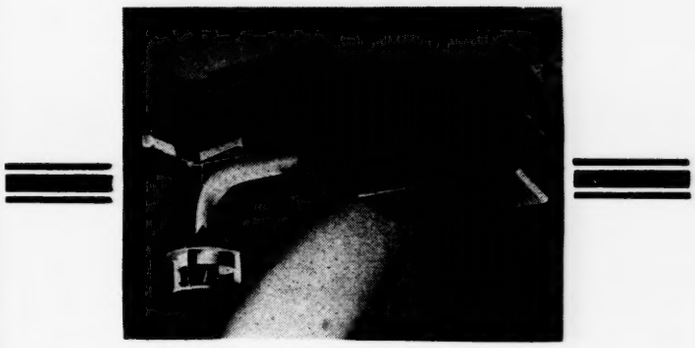
INDUSTRIAL DEGREE-DAYS
December, 1946

City	55F Base	45F Base
Baltimore, Md.	138	11
Buffalo, N. Y.	326	97
Chicago, Ill.	379	128
Cleveland, Ohio	288	73
Detroit, Mich.	341	84
Indianapolis, Ind.	257	63
New York, N. Y.	187	33
Philadelphia, Pa.	155	19
Pittsburgh, Pa.	270	70
St. Louis, Mo.	355	108

CANADIAN DEGREE-DAYS FOR NOVEMBER, 1946

City	November 1946	November Normal	Cumulative, Sept. 1 to Nov. 30 1946	Cumulative, Sept. 1 to Nov. 30 Normal
Calgary, Alta.	1362	1122	2612	2276
Charlottetown, P. E. I.	840	858	1448	1619
Crescent Valley, B. C.	1062	981	2186	2039
Edmonton, Alta.	1419	1215	2721	2406
Fort William, Ont.	1146	1143	2246	2219
Grand Prairie, Alta.	1512	1218	2784	2510
Halifax, N. S.	751	789	1308	1477
London, Ont.	753	843	1239	1477
Medicine Hat, Alta.	1326	1104	2447	1972
Moncton, N. B.	903	936	1583	1813
Montreal, P. Q.	868	948	1463	1689
North Bay, Ont.	1032	1017	1829	1975
Ottawa, Ont.	897	984	1561	1783
Penticton, B. C.	972	813	1797	1553
Porquis Junction, Ont.	1233	1266	2212	2462
Prince George, B. C.	1344	1068	2658	2253
Quebec City, P. Q.	975	1050	1633	1977
Regina, Sask.	1500	1355	2799	2557
St. John, N. B.	795	870	1412	1698
Saskatoon, Sask.	1488	1572	1305	2482
Toronto, Ont.	669	817	1135	1489
Vancouver, B. C.	783	657	1554	1350
Victoria, B. C.	696	462	1405	1172
Windsor, Ont.	672	795	1009	1274
Winnipeg, Man.	1356	1302	2527	2376

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.



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TRIED AND PROVED! In every section of the country users are enjoying trouble-free, efficient automatic heat from Gregory Burners, which are abundantly fulfilling all their expectations. The high thermal efficiency of the Gregory is due to a combination of time-tested and approved controls,—each representing the best in its field—A.G.A. approved—with the Gregory special diffuser type burner, which directs the flame against the walls of the combustion chamber. Guaranteed for One Full Year!

EASY TO INSTALL— Gas inlet headers permit the gas supply to be connected on either side of the burner. Pilot connection is reversible. Leveling of the burner unit inside the firebox requires only a few minutes. The total assembly and installation is accomplished quickly, without cooling the house.

ONE SIZE MEETS ALL REQUIREMENTS— The Gregory is a one-size burner of sufficient flexibility to take care of the vast majority of home heating plants.

COMPACT—SAFE—CLEAN! The Gregory unit occupies the least practical space outside the heater, and controls and connections are all enclosed in a steel housing of hammered-bronze, baked enamel finish, harmonizing with any finish on heater and surroundings, and proof against scratching or marring.

PROFITABLE TO SELL AND USE. Scientific design based on broadest experience in gas combustion engineering, and precision manufacture in quantity, gives a unit that can be sold to the broadest market and at a good profit.

DISTRIBUTORS—WRITE! Get in line for the coming season! Gas is the coming fuel, the Gregory Burner will enable you and your customers to take full advantage of its great convenience, comfort and genuine economy. Distributorships in certain areas are open—Let us hear from you! Write today.

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